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Earth is (mostly) flat: apportionment of the flux of continental sediment over millennial time scales

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Earth is (mostly) flat: apportionment of the flux of continental sediment over millennial time scales

Abstract

We use a new compilation of global denudation estimates from cosmogenic nuclides to calculate the apportionment and the sum of all sediment produced on Earth by extrapolation of a statistically significant correlation between denudation rates and basin slopes to watersheds without denudation rate data. This robust relationship can explain approximately half of the variance in denudation from quartz-bearing topography drained by rivers using only mean slopes as the predictive tool and matches a similar fit for large river basins. At slopes >200 m/km, topography controls denudation rates. Controls on denudation in landscapes where average slopes are 10 mm/k.y. We use global topographic data to show that the vast majority of the Earth's surface consists of these gently sloping surfaces with modest, but positive, gross denudation rates, and that these areas contribute the most sediment to the oceans. Because of the links between silicate weathering rates and denudation rates, the predominance of low sloping areas on the Earth's surface compared to areas of steep mountainous topography implies that mountain uplift contributes little to drawdown of CO₂ at cosmogenic nuclide time scales of 10³–10⁶ yr. The poorly understood environmental controls that set the pace of denudation for the largest portion of Earth's surface hold the key to understanding the feedbacks between erosion and climate.

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1 The Earth is (mostly) flat: Apportionment of the flux of 2 continental sediment over millennial time scales

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11 **ABSTRACT**

12 We use a new compilation of global denudation estimates from cosmogenic
13 nuclides to calculate the apportionment and the sum of all sediment produced on the
14 Earth by extrapolation of a statistically significant correlation between denudation rates
15 and basin slopes to watersheds without denudation rate data. This robust relationship can
16 explain approximately half of the variance in denudation from quartz-bearing topography
17 drained by rivers using only mean slopes as the predictive tool and matches a similar fit
18 for large river basins. Above 200 m/km slopes, topography controls denudation rates.
19 Controls on denudation in landscapes where average slopes are < ~200 m/km are unclear,
20 but sediment production rates in these areas average ~45 mm/k.y. with 75% of the
21 denudation rates being greater than 10 mm/k.y. We use global topographic data to show
22 that the vast majority of the Earth's surface consists of these gently sloping surfaces with

modest, but positive, gross denudation rates, and that these areas contribute the most sediment to the oceans. Because of the links between silicate weathering rates and denudation rates, the predominance of low sloping areas on the Earth's surface compared to areas of steep mountainous topography implies that mountain uplift contributes little to drawdown of CO₂ at cosmogenic nuclide time scales of 10³-10⁶ yr. The poorly understood environmental controls that do set the pace of denudation for the largest portion of Earth's surface hold the key to understanding the feedbacks between erosion and climate.

INTRODUCTION

Understanding the controls on fluxes of sediment from continents to the ocean is critical for understanding rates of mass transfer among global sediment reservoirs, as well as elemental fluxes (Plank and Langmuir, 1998), nutrient cycles (Meybeck, 1982), inputs to organic carbon sinks (Ludwig et al., 1996), and their respective changes over short and long time scales. Fluxes of variably-weathered sediment through rivers are also linked to dissolved solute fluxes (West et al., 2005), a relation of critical importance because the rate of weathering and metamorphism of silicate and carbonate minerals serves to transfer CO₂ between the atmosphere and lithosphere, thereby regulating atmospheric CO₂ concentrations over geologic time scales (Berner et al., 1983).

The movement of sediment and chemical solutes through river basins is a highly episodic process (e.g., Kirchner et al., 2001) that empirical relationships have shown to be grossly dependent on watershed topography, climate, and other environmental and cultural factors (Syvitski and Milliman, 2007). Topographic indices are best correlated with sediment flux, and these empirical fits include linear, exponential, and power law

relations between erosion rate and mean elevation (Berner and Berner, 1987), local relief (Ahnert, 1970), and catchment slope (Aalto et al., 2006). Recent work has shown that significant variability in short-term sediment flux measurements is introduced by stochastic processes such as intermittent release of stored sediment in a watershed (van der Wiel and Coulthard, 2010). For watersheds with high internal variability of storage and release of sediment, the magnitude of noise (the stochastic contribution to the total flux) can be larger than environmental and/or physiographic forcing (Jerolmack and Paola, 2010) and, in some cases, can completely obliterate long-term signals such as those of climate change and tectonism. Because short-term measurements are more readily masked by noise than are measurements averaged over long time scales, only after thousands of years are sediment and solute fluxes likely to be dominated by actual extrinsic forcing mechanisms (Jerolmack and Sadler, 2007). In such cases, exhumation rates determined via thermochronometry and the rates of geomorphic evolution of the landscape should be, and often are, in agreement (von Blanckenburg, 2005; Kirchner et al., 2001). Sediment yields from the Earth's largest basins may mimic the robust response of long-term measurements to external forcing, like those from cosmogenic nuclides, because buffering mechanisms can integrate change over thousands of years (Métivier and Gaudemer, 1999; Phillips, 2003).

Understanding how sediment flux to modern oceans compares to those over geologic history with decidedly different climates is confounded by comparing noisy, short-term values to those averaged over much longer time scales. Fortunately, average river basin sediment fluxes can be directly determined over long time scales with the use of cosmogenic nuclide geochemical tracers. Since this technique was first applied some

two decades ago, over 1,500 flux determinations have been published (Portenga and Bierman, 2011). This large data set over a wide range of topographic settings – both stable and tectonically active (Fig. 1) – allows us to extrapolate to unmeasured basins utilizing empirical relations derived from available data. With this approach, we assess the production of continental sediments at time scales of 1 k.y. to 1 m.y. and compare this rate to those determined from fluvial suspended sediment loads from large rivers (Summerfield and Hulton, 1994) and from continental sediment and rock volumes over geologic times (Wilkinson and McElroy, 2007).

¹⁰BE-DERIVED DENUDATION RATES AND THE DISTRIBUTION OF EARTH'S SLOPES

We have compiled data on concentrations of cosmogenic ¹⁰Be in fluvial sediments that have been published in refereed literature from the inception of the technique through 2011 (Table DR1 in GSA Data Repository¹). Our compilation is similar in scope and size to that recently published by Portenga and Bierman (2011), although it is completely independent from it. All ¹⁰Be concentrations and denudation rates were recalculated, full details and data being provided in the Data Repository.

To complement the ¹⁰Be data, we have derived appropriate topographic metrics from 3 arc second (nominally 90 m) Shuttle Radar Topography Mission (SRTM) data (<http://srtm.csi.cgiar.org>) for each discrete drainage basin whose outlet is the ¹⁰Be sampling site. Due to the coarse resolution of the DEM data that we use in our analysis, and given the difficulty of accurately identifying and delineating very small river basins using these data, we limit our analysis to river basins with areas >1 km². Further, we also exclude the very large basins (see Table DR1 in the Data Repository), as mean

topographic metrics derived for these will most likely be meaningless. The resulting data set includes 990 river basins with areas between 1 and 10,000 km² (Fig. 1), with mean denudation rates derived from ¹⁰Be in their sediment, mean basin elevation, elevation range, mean basin slope, and standard deviation of slope (see the Data Repository).

Given that the SRTM data is not global in coverage, for our global sediment flux calculations we use the U.S. Geological Survey's GTOPO30 data and its derivative, HYDRO1K. We calculate slope for Earth's ice-free areas using a 5 × 5 km moving window, so that the obtained values are comparable to the average basin slopes obtained for the 990 river basins. We chose a 5 × 5 km window because the majority of our basins' areas are in this range (Fig. 1, inset). Using larger windows, however, does not significantly change the results (Fig. DR1 in the Data Repository). We identify and separate endorheic basins from those draining to the ocean (Fig. 1, top inset).

RESULTS

Erosion rates from sediment derived ¹⁰Be concentrations span several orders of magnitude, ranging from below 0.5 to over 6000 mm/k.y. (Fig. 2A). Given that our compilation of denudation rates does not represent an unbiased sample of erosional, continental environments, the calculation of a global continental sediment production rate must account for a weighting of rate based on area.

At millennial time scales, the functional form of the denudation rate (D, mm/k.y.) versus mean slope (S, m/km) relation, obtained from our 990 river basins, is (Fig. 2A):

$$D = 11.9e^{0.0065S} \quad (1)$$

Equation 1 is very similar to the one obtained from the river load data of Summerfield and Hulton (1994), namely $D = 6.1e^{0.0071S}$ (Fig. 2A), and predicts that the

rate of denudation increases exponentially with slope by ~0.65% for each meter per kilometer increase in slope. While substantial variability is present in the data, reflecting the dependence of erosion on other environmental factors (Milliman and Syvitski, 1992; Portenga and Bierman, 2011), here we focus on the fact that mean basin slope explains over half of the global variance of denudation rates at cosmogenic nuclide time scales ($R^2 = 0.48$; $p < 0.01$) and that the residuals sum to zero. Thus, although the data are ‘noisy’, the best-fit curve still accounts for the majority of variation in average denudation rate in basins all across the globe.

Based on the GTOPO30 data, 52% of the Earth’s surface has mean slope below 10 m/ km (~0.6 degrees), and 92.5% below 100 m/km(~6 degrees) (Fig. 1). The percentages are virtually the same (50.3 and 92.2%) if endorheic basins are excluded. This means that a global sediment production rate calculated using Equation (1) will be strongly controlled by the intercept; i.e., 11.9 mm/k.y. The functional relationship between denudation rate and slope essentially breaks down for slope values $< \sim 200$ m/km (~10 degrees), as the subset of the data from 0 to 200 m/km shows no correlation between slope and denudation rate (Fig. 2B); this subset however, has a minimal influence on the form of Equation 1, when removed the latter becoming: $D = 10.7e^{0.0067S}$. Despite the lack of a relationship for slopes < 200 m/km, between denudation rate and slope, we note that all data in this subset, with the exception of those from extreme desert settings (see Table DR1), have denudation rates > 5 mm/k.y., and 75% of the denudation rates are > 10 mm/k.y. Further, the data in this subset span a wide range of latitudes and altitudes (Figs. 2C and 2D), and therefore also a wide range of climatic settings. The lack of a relationship between topography and denudation rate over a wide range of climatic

settings combined with the fact that 75% of the denudation rates in the 0–200 m/km subset are above >10 mm/k.y. makes us surmise that despite being seemingly large, the intercept of Equation 1 is a valid approximation of the average rate at which ~50% of the Earth's surface is eroding.

Summing the above relation between average denudation rate and basin slope for continental slopes derived from GTOPO30 (Fig. 3) yields an annual global sediment production rate of 5.5 Gt (Fig. 3), although this value could be as low as 0.6 Gt or as high as 6.7 Gt based on propagation of a $\pm 1\sigma$ standard error estimate. Excluding endorheic basins lowers this estimate to 4.4 Gt, suggesting that as much as ~20% of the sediment produced does not discharge into the oceans. Because cosmogenic nuclide concentrations reflect total denudation, these sediment production rates include both chemical and physical erosion.

DISCUSSION

The relation given in Equation 1 implies orders of magnitude variation in denudation rates across Earth's surface as a function of basin-scale slope alone. This relation saturates (i.e., denudation rates grows very quickly with small slope changes) around 700–900 m/km (35–40 degrees) in close agreement with the threshold slope determined by Montgomery and Brandon (2002). This is clear evidence that production of sediment per unit area is much greater in mountainous regions than in lowlands in agreement with a suite of studies of continental denudation (e.g., Milliman and Syvitski, 1992).

In order to better understand the production of sediment as a function of basin characteristics, the frequency distribution (by area, Fig. 3A) of global basin slopes was

used to estimate the total sediment production as a function of slope (Fig. 3B). This displays an overall inverse relation between slope and sediment production, not because lower slopes erode faster, but because they encompass areas vast enough to outweigh the production rate differential between steep and lowland regions. A different conclusion was reached by Milliman and Syvitski (1992) when they estimated that small mountain rivers contribute the most sediment to the world's oceans. We find a potentially opposing result that the low sloping areas of the world erode slowly but steadily over a very large area – overpowering the high-mountainous small rivers when one accounts for the relatively small areas of those mountainous regions. It is important to note that because the compiled cosmogenic data in this work were collected in denuding landscapes, these rates are representative of gross denudation (chemical and physical erosion) and not net denudation in their respective environments like those for the Milliman and Syvitski (1992) estimate. While mountainous areas are likely to witness little deposition overall, low-sloping areas are prone to deposition. This complicating factor makes directly comparing the result of Milliman and Syvitski (1992) and this work impossible. Yet, in terms of total gross denudation, large low-sloping areas are sites of the greatest fraction of the total denudation.

Comparison with Other Data on Denudation and Sediment Delivery

Area-slope normalized suspended and dissolved fluxes for the 36 largest river basins draining ice-free continental surfaces exhibit strong similarity to the relation for cosmogenic nuclide-derived denudation rates versus slope; they show equivalent ranges of values and, when normalized for slope, globally averaged cosmogenic nuclide-derived denudation rates lie within the range of modern river sediment fluxes to the world's

oceans (Summerfield and Hulton, 1994) (Fig. 2A; see also Table DR2). We speculate that sediment fluxes over these two seemingly different time scales are similar because large watersheds serve to temporarily store sediments en route to oceanic delivery over these time scales. This conforms with existing hypotheses that large watersheds act as buffers for climatic and anthropogenic forcing (Métivier and Gaudemer, 1999; Phillips, 2003). As such, the time scale of integration for sediment yield measurements of modern rivers with sediment storage might be better conceptualized as the residence time of sediment in the basin transport system (i.e., the volume of sediment held on the landscape divided by the flux of sediment through the system) rather than the number of years over which the measurements are made. Métivier and Gaudemer (1999) demonstrate that, for the world's largest rivers, this value can be 10–100 k.y.

Compared to rates of sediment cycling based on remnant Phanerozoic sediment stores (5 Gt/y; Wilkinson and McElroy, 2007), the globally averaged cosmogenic nuclide-derived sediment production rate of 5.5 Gt/y (4.4 Gt/y excluding endorheic basins) is essentially equivalent.

Implications for the Global Silicate Weathering Flux

Various studies (West et al., 2005, and references therein) have found a strong relationship between the total denudation rate and the silicate weathering flux in river basins. Our new data set and analysis allow us to estimate the total global silicate flux from these previously published relationships. In the empirical relationship of West et al. (2005), they and others (Carson and Kirkby, 1972; Stallard and Edmond, 1983; Hilley and Porder, 2008) note that watersheds may be classed into being either (1) *transport limited*—where minerals are nearly completely altered before their removal or (2)

207 *kinetically limited*—where the alteration of minerals is incomplete. The transport limited
208 settings make up most of the land area on Earth, and in these settings the total rates of
209 denudation show a better correlation with silicate cation fluxes. The kinetically limited
210 cases are not well correlated with silicate cation fluxes and are typically found in areas
211 that are rapidly eroding and experiencing uplift, and comprise a small portion of the
212 landscape. In these kinetically-limited cases, West et al. (2005) note a case of diminishing
213 returns where a larger denudation rate does not necessarily result in a larger silicate
214 cation flux like the transport-limited relationship shows.

215 Using the relationship between river denudation and river chemistry and our
216 estimate of the total global denudation rate, the silicate cation denudation rate is equal to
217 0.6 t/km per year. If we assume that each mol of silicate cation reacts with 1 mol of CO₂,
218 then we calculate 0.72×10^8 tCO₂/yr for the ice-free area of the Earth. This amount is
219 lower than previously published values ($5.1\text{--}5.5 \times 10^8$ tCO₂/yr; Meybeck, 1982; Berner et
220 al., 1983; Gaillardet et al., 1999), but close to recent numerical modeling work ($1.5\text{--}3.3 \times$
221 10^8 tCO₂/yr; Hilley and Porder, 2008). Given that our results only constrain denudation
222 rates for fluvially dissected landscapes that contain quartz, our calculated value should be
223 considered a minimum, as mafic rocks have minerals with a greater proportion of Ca and
224 Mg to supply for carbonate formation.

225 Global compilations show that silicate weathering rates and denudation rates are
226 tightly correlated (West et al., 2005). If this is true, and the greatest sensitivity of the
227 Earth's surface to changes in denudation lie in low sloping areas where small denudation
228 rate changes of these large areas drastically increase the average global denudation rate
229 (Fig. 3B), then this result has great consequences on global changes in the silicate

weathering cycle and rates of CO₂ drawdown. Considering that steeply sloping mountain belts such as the Himalayas, Alps and Andes are only a small proportion of the continental land surface compared to the areas of low-slopes (Fig. 1), and that topography (thus tectonics) does not control denudation rates in these low-sloping areas (Fig. 2B), we postulate that increased mountain building represents only a minor contribution to global CO₂ withdrawal unless the total area of the world taken up by mountains increases substantially. Thus, the real driver of denudation and geomorphically or environmentally driven climate change remains unknown.

CONCLUSIONS

We calculate the sum of all sediment produced for the (quartz-containing) Earth by extrapolation of a statistically significant correlation between cosmogenic nuclide-derived long-term denudation rates and basin slopes to watersheds without denudation rate data. This relationship can explain approximately half of the variance in denudation from quartz bearing topography drained by rivers using only mean slopes. However, we do not know what controls denudation in landscapes where average slopes are < ~200 m/km, but the control that sets the pace of this zone, holds the key to understanding the feedbacks between erosion and climate. The total mass flux determined from our tally is 5.5 Gt/yr and agrees well with the mass flux from previous global studies from solute and sediment gauging data (Summerfield and Hulton, 1994; Syvitski and Milliman, 2007) and Phanerozoic rock volumes (Wilkinson and McElroy, 2007).

Finally, we suggest that identifying conditions sufficient to significantly impact the global flux of solid sediments and solutes to oceans in the low sloping areas is the

next crucial area of research to elucidate geologically historical rates and magnitudes of
element cycling on Earth.

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REFERENCES CITED

- Aalto, R., Dunne, T., and Guyot, J.L., 2006, Geomorphic controls on Andean denudation
rates: *The Journal of Geology*, v. 114, p. 85–99, doi:10.1086/498101.
- Ahnert, F., 1970, Functional relationship between denudation, relief, and uplift in large
mid-latitude drainage basins: *American Journal of Science*, v. 268, p. 243–263,
doi:10.2475/ajs.268.3.243.
- Berner, E.K., and Berner, R.A., 1987, *The Global Water Cycle - Geochemistry and
Environment*: Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 398 pp.
- Berner, R.A., Lasaga, A.C., and Garrels, R.M., 1983, The carbonate–silicate geochemical
cycle and its effect on atmospheric carbon dioxide over the past 100 million years:
American Journal of Science, v. 283, p. 641–683, doi:10.2475/ajs.283.7.641.
- Carson, M.A., and Kirkby, M.J., 1972, *Hillslope Form and Process*: Cambridge, UK,
Cambridge University Press, 475 p.

- 275 Gaillardet, J., Dupre, B., Louvat, P., and Allegre, C., 1999, Global silicate weathering and
276 CO₂ consumption rates deduced from the chemistry of large rivers: Chemical
277 Geology, v. 159, p. 3–30, doi:10.1016/S0009-2541(99)00031-5.
- 278 Hilley, G.E., and Porder, S., 2008, A framework for predicting global silicate weathering
279 and CO₂ drawdown rates over geologic time-scales: Proceedings of the National
280 Academy of Sciences of the United States of America, v. 105, no. 44, p. 16855–
281 16859, doi:10.1073/pnas.0801462105.
- 282 Jerolmack, D.J., and Paola, C., 2010, Shredding of environmental signals by sediment
283 transport: Geophysical Research Letters, v. 37, L19401,
284 doi:10.1029/2010GL044638.
- 285 Jerolmack, D.J., and Sadler, P., 2007, Transience and persistence in the depositional
286 record of continental margins: Journal of Geophysical Research, v. 112, F03S13,
287 doi:10.1029/2006JF000555.
- 288 Kirchner, J., Finkel, R., Riebe, C., Granger, D., Clayton, J., King, J., and Megahan, W.,
289 2001, Mountain erosion over 10 yr, 10 k.y, and 10 m.y. time scales: Geology, v. 29,
290 no. 7, p. 591–594, doi:10.1130/0091-7613(2001)029<0591:MEOYKY>2.0.CO;2.
- 291 Ludwig, W., Probst, J.-L., and Kempe, S., 1996, Predicting the oceanic input of organic
292 carbon by continental erosion: Global Biogeochemical Cycles, v. 10, no. 1, p. 23–41,
293 doi:10.1029/95GB02925.
- 294 Métivier, F., and Gaudemer, Y., 1999, Stability of output fluxes of large rivers in South
295 and East Asia during the last 2 million years: Implications on floodplain processes:
296 Basin Research, v. 11, p. 293–303, doi:10.1046/j.1365-2117.1999.00101.x.

- 297 Meybeck, M., 1982, Carbon, nitrogen, and phosphorus transport by world rivers:
298 American Journal of Science, v. 282, no. 4, p. 401–450, doi:10.2475/ajs.282.4.401.
- 299 Milliman, J.D., and Syvitski, J.P.M., 1992, Geomorphic/tectonic control of sediment
300 discharge to the ocean: The importance of small mountainous rivers: The Journal of
301 Geology, v. 100, p. 525–544, doi:10.1086/629606.
- 302 Montgomery, D., and Brandon, M., 2002, Topographic controls on erosion rates in
303 tectonically active mountain ranges: Earth and Planetary Science Letters, v. 201,
304 no. 3–4, p. 481–489, doi:10.1016/S0012-821X(02)00725-2.
- 305 Phillips, J., 2003, Alluvial storage and the long-term stability of sediment yields: Basin
306 Research, v. 15, p. 153–163, doi:10.1046/j.1365-2117.2003.00204.x.
- 307 Plank, T., and Langmuir, C., 1998, The chemical composition of subducting sediment
308 and its consequences for the crust and mantle: Chemical Geology, v. 145, p. 325–
309 394, doi:10.1016/S0009-2541(97)00150-2.
- 310 Portenga, E.W., and Bierman, P.R., 2011, Understanding Earth's eroding surface with
311 ¹⁰Be: GSA Today, v. 21, no. 8, p. 4–10, doi:10.1130/G111A.1.
- 312 Stallard, R.F., and Edmond, J.M., 1983, Geochemistry of the Amazon 2. The influence of
313 geology and weathering environment on the dissolved load: Journal of Geophysical
314 Research, v. 88, p. 9671–9688, doi:10.1029/JC088iC14p09671.
- 315 Summerfield, M.A., and Hulton, N.J., 1994, Natural controls of fluvial denudation rates
316 in major world drainage basins: Journal of Geophysical Research, v. 99, p. 13871–
317 13883, doi:10.1029/94JB00715.

- Syvitski, J.P.M., and Milliman, J.D., 2007, Geology, geography, and humans battle for dominance over the delivery of fluvial sediment to the coastal ocean: *The Journal of Geology*, v. 115, p. 1–19, doi:10.1086/509246.
- van der Wiel, M.J., and Coulthard, T.J., 2010, Self-organized criticality in river basins: Challenging sedimentary records of environmental change: *Geology*, v. 38, p. 87–90, doi:10.1130/G30490.1.
- von Blanckenburg, F., 2005, The control mechanisms of erosion and weathering at basin scale from cosmogenic nuclides in river sediment: *Earth and Planetary Science Letters*, v. 237, p. 462–479, doi:10.1016/j.epsl.2005.06.030.
- West, A.J., Galy, A., and Bickle, M., 2005, Tectonic and climatic controls on silicate weathering: *Earth and Planetary Science Letters*, v. 235, no. 1–2, p. 211–228, doi:10.1016/j.epsl.2005.03.020.
- Wilkinson, B., and McElroy, B., 2007, The impact of humans on continental erosion and sedimentation: *Geological Society of America Bulletin*, v. 119, p. 140–156, doi:10.1130/B25899.1.

FIGURE CAPTIONS

Figure 1. Global distribution of slope as calculated from the GTOPO30 DEM and averaged using a 5×5 km moving window, and the distribution of river basins that were used to determine global denudation rates (red circles). Top inset: the distribution of endorheic basins. Bottom inset: histogram (bars) of basin areas in this compilation. Note the log scale on the x -axis. See text for more details.

Figure 2. (A) Mean drainage basin slopes from 90 m Shuttle Radar Topography Mission (SRTM) topographic data versus basin-wide denudation rates from cosmogenic ^{10}Be in

river sediment (circles) and large-river denudation rates (squares) from Summerfield and Hulton, (1994). (B) Same as (A) but showing only those basins that have an average slope less than 200 m/km. The black dashed horizontal line is the median of the data and the gray box bounds 50% of the data. Note the absence of a correlation between denudation rate and slope. (C) and (D) Denudation rates of basins with slopes less than 200 m/km versus geographic latitude and average basin elevation. See text for more details.

Figure 3. (A) Slope (x-axis) versus denudation rate predicted by Eq. 1 (right axis; gray dashed curve), cumulative land area (red curves) and, as the product of denudation rate and area, total sediment production rate (blue curves). The dashed blue and red curves mark area and sediment production with endorheic basins removed. The summation over all continental area yields a net (chemical and physical) global sediment production rate of ~5.5 Gt/yr. (B) Sensitivity analysis exploring the contribution to the total global sediment flux of areas with slopes below 10 m/km (~0.6 degrees), 20 m/km (~1.2 degrees), and 100 m/km (~6 degrees) as a function of their average denudation rates. Using the values predicted by Eq. 1 (yellow circles), these areas contribute around 40%, 53%, and 81% of the total sediment flux, respectively. Even when the denudation rate is lowered to 5 mm/k.y. (see Fig. 2B), these values are still around 21%, 31%, and 62%, respectively. The dashed curves are obtained when endorheic basins are removed.

¹GSA Data Repository item 2013xxx, Table DR1 (complete dataset of ¹⁰Be-derived denudation rates and topographic metrics used in this work), Table DR2 (previous estimates of sediment delivery to oceans) and the original references for these datasets in

364 Tables DR1 and DR2, are available online at www.geosociety.org/pubs/ft2013.htm, or on
365 request from editing@geosociety.org or Documents Secretary, GSA, P.O. Box 9140,
366 Boulder, CO 80301, USA.

Figure 1

FIGURE 1

Figure 2

FIGURE 2

Figure 3

FIGURE 3

GSA Supplementary Material

The Earth is (mostly) flat: Apportionment of the flux of continental sediment over millennial timescales

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Be-10 COMPILATION

Catchment wide denudation rates were calculated using the re-normalised (2007 KNSTD) Be-10 concentrations, and following the formalism of Schaller et al. (2001) with Be-10 sea level high latitude (SLHL) production rates of: 4.5 ± 0.5 atoms.g⁻¹.y⁻¹ for high-energy neutrons, 0.097 ± 0.007 atoms.g⁻¹.y⁻¹ for slow muons, and 0.085 ± 0.012 atoms.g⁻¹.y⁻¹ for fast muons. The Be-10 SLHL production rate for high-energy neutrons was recalculated from Balco et al.'s (2008) Be-10 calibration-site dataset, using the time-independent altitude/latitude scaling scheme of Dunai (2000) and a Be-10 half-life of 1.387 ± 0.012 m.y. (Chmeleff et al., 2010; Korschinek et al., 2010). The Be-10 SLHL production rates for muons were taken from Kubik et al. (2009) and are based on Heisinger et al. (2002a,b). All Be-10 SLHL production rates were corrected for altitude and latitude using the time-independent scaling scheme of Dunai (2000) and for topographic shielding following Codilean (2006). All calculations were performed on a pixel-by-pixel basis using the 90m SRTM DEM (<http://srtm.csi.cgiar.org/>). At sites where duplicate measurements were made or multiple grain-size fractions were analysed, denudation rates were averaged.

REFERENCES:

- 1 Balco, G., Stone, J.O., Lifton, N.A., and Dunai, T.J., 2008, A complete and easily accessible means of calculating surface exposure ages or erosion rates from Be-10 and 26Al measurements: Quaternary Geochronology, v. 3, p. 174–195, doi: 10.1016/j.quageo.2007.12.001.
- 2 Chmeleff, J., von Blanckenburg, F., Kossert, K., and Jakob, D., 2010, Determination of the Be-10 half-life by multicollector ICP-MS and liquid scintillation counting: Nuclear Instruments and Methods In Physics Research Section B, v. 268, p. 192–199, doi: 10.1016/j.nimb.2009.09.012.
- 3 Codilean, A.T., 2006, Calculation of the cosmogenic isotope production topographic shielding scaling factor for large areas using DEMs: Earth Surface Processes and Landforms, v. 31, p. 785–794, doi: 10.1002/esp.1336.
- 4 Dunai, T.J., 2000, Scaling factors for production rates of in situ produced cosmogenic nuclides: a critical reevaluation: Earth and Planetary Science Letters, v. 176, p. 157–169, doi: 10.1016/S0012-821X(99)00310-6.
- 5 Heisinger, B., Lal, D., Jull, T.A.J., Kubik, P.W., Ivy-Ochs, S., Neumaier, S., Knie, K., Lazarev, V., and Nolte, E., 2002a, Production of selected cosmogenic radionuclides by muons 1. Fast muons: Earth and Planetary Science Letters, v. 200, p. 345–355, doi: 10.1016/S0012-821X(02)00640-4.
- 6 Heisinger, B., Lal, D., Jull, T.A.J., Kubik, P.W., Ivy-Ochs, S., Knie, K., and Nolte, E., 2002b, Production of selected cosmogenic radionuclides by muons: 2. Capture of negative muons: Earth and Planetary Science Letters, v. 200, p. 357–369, doi: 10.1016/S0012-821X(02)00641-6.
- 7 Korschinek, G., Bergmaier, A., Faestermann, T., Gerstmann, U.C., Knie, K., Rugel, G., Wallner, A., Dillmann I., Dollinger, G., Lierse von Gostomski, Ch., Kossler, K., Maiti, M., Poutivtsev, M., and Remmert, A., 2010, A new value for the half-life of Be-10 by heavy ion elastic recoil detection and liquid scintillation counting: Nuclear Instruments and Methods In Physics Research Section B, v. 268, p. 187–191, doi: 10.1016/j.nimb.2009.09.020.
- 8 Kubik, P.W., Christl, M., and Alfimov, V., 2009, New Primary Be-10 standard and T1/2 for AMS at ETH: Ion Beam Physics, ETH Zurich Annual report, p. 12. Online at: www.ams.ethz.ch/publications/annual_reports/2009
- 9 Schaller, M., von Blanckenburg, F., Hovius, N., and Kubik, P.W., 2001, Large-scale erosion rates from in situ-produced cosmogenic nuclides in European river sediments: Earth and Planetary Science Letters, v. 188, p. 441–458, doi: 10.1016/S0012-821X(01)00320-X.

Table DR1: Global compilation of detrital Be-10-based denudation rates

No	First Author	Year of Publication	Reference ID	Sample ID	Published Sample ID	Longitude (WGS degrees)	Latitude (WGS degrees)	Denudation Rate (mm/k.y.)	D.R. Uncertainty (mm/k.y.)	Basin Area (km ²)	Elevation Range (m)	Mean Elevation (m)	Mean Slope (m/km)	Slope Stdev (m/km)	Mean Slope (degrees)	Slope Stdev (degrees)
1	Bierman	1998	1998BookChapter	WTS03001	TC-1	134.398144	-23.517648	18.62	2.31	432.0	602	736.6	61.6	93.6	3.4	4.9
2	Bierman	1998	1998BookChapter	WTS03002	TC-2	134.392063	-23.524184	20.25	2.70	433.4	608	736.2	62.1	94.4	3.5	5.0
3	Bierman	1998	1998BookChapter	WTS03003	TC-3	134.433106	-23.566594	14.53	2.04	473.0	647	724.0	67.6	99.1	3.8	5.2
4	Bierman	1998	1998BookChapter	WTS03005	WP-8	138.575576	-31.557058	4.70	0.53	21.8	436	662.8	115.9	119.8	6.5	6.6
5	Bierman	1998	1998BookChapter	WTS03006	WP-9	138.590115	-31.545108	2.52	0.30	72.3	546	694.3	128.0	115.1	7.2	6.3
6	Brown	1998	1998EPSL160	WTS04001	CAY1	-65.957672	18.155331	69.77	17.11	26.3	274	289.5	94.4	58.6	5.4	3.3
7	Riebe	2000	2000Geo28	WTS05003	GD-12	-121.359062	39.887553	177.74	28.31	1.5	880	1164.5	505.4	211.8	26.0	10.1
8	Riebe	2000	2000Geo28	WTS05006	AL-8	-120.648703	40.148160	33.57	4.00	1.1	177	1755.8	196.3	112.6	11.0	6.1
9	Bierman	2001	2001AmJSci301	WTS06001	NAM-08	16.449449	-23.317906	4.73	0.53	65.6	170	1828.3	39.0	20.7	2.2	1.2
10	Bierman	2001	2001AmJSci301	WTS06002	NAM-09	16.300130	-23.247544	15.45	1.75	14.5	466	1666.6	197.8	110.9	11.0	5.9
11	Bierman	2001	2001AmJSci301	WTS06003	NAM-16	15.773434	-23.303253	8.62	0.94	6554.5	1595	1392.6	132.6	121.3	7.4	6.5
12	Bierman	2001	2001AmJSci301	WTS06005	NAM-46	15.571457	-21.915011	6.83	0.78	4791.5	1327	1320.2	107.7	88.9	2.3	4.7
13	Schaller	2001	2001EPSL188	WTS07001	reg-5	12.120858	49.121429	29.22	5.21	2798.6	360	430.2	76.0	60.9	4.3	3.4
14	Schaller	2001	2001EPSL188	WTS07002	reg-7	12.399889	49.180615	28.20	3.75	2365.7	578	466.3	90.2	63.0	5.1	3.6
15	Schaller	2001	2001EPSL188	WTS07003	reg-11	12.738258	49.242804	23.59	3.16	398.3	703	525.4	112.4	75.9	6.4	4.2
16	Schaller	2001	2001EPSL188	WTS07004	reg-12A	12.736185	49.186903	29.64	3.89	1402.8	1034	548.4	134.8	75.4	7.6	4.2
17	Schaller	2001	2001EPSL188	WTS07007	reg-13	12.844457	49.171222	30.96	3.99	236.7	1031	697.4	178.9	92.1	10.1	5.0
18	Schaller	2001	2001EPSL188	WTS07008	reg-14	12.837990	49.145738	25.27	3.18	1027.7	1025	670.1	142.4	76.8	8.1	4.3
19	Schaller	2001	2001EPSL188	WTS07009	reg-18A	13.232567	49.048262	33.38	5.57	165.7	848	902.7	183.4	89.0	10.3	4.8
20	Schaller	2001	2001EPSL188	WTS07012	reg-19-1	13.254695	49.014618	28.38	3.68	112.3	860	868.6	155.1	83.2	8.8	4.6
21	Schaller	2001	2001EPSL188	WTS07013	reg-19-2	13.254727	49.014619	28.38	3.71	112.3	860	868.6	155.1	83.2	8.8	4.6
22	Schaller	2001	2001EPSL188	WTS07014	reg-20	13.215265	49.010734	33.41	4.32	305.0	795	676.3	130.9	72.1	7.4	4.0
23	Schaller	2001	2001EPSL188	WTS07015	neck-1	8.617113	48.179196	55.92	7.82	427.4	65	747.5	30.6	4.8	1.8	0.3
24	Schaller	2001	2001EPSL188	WTS07016	neck-2	8.648274	48.396322	103.90	17.09	770.1	3	932.5	43.8	2.1	2.5	0.1
25	Schaller	2001	2001EPSL188	WTS07017	neck-3	9.419309	46.703719	102.42	16.76	331.6	716	246.6	97.9	95.7	5.5	5.2
26	Schaller	2001	2001EPSL188	WTS07025	neck-8	9.158036	49.003964	135.17	19.89	5700.5	6	691.0	50.2	12.4	2.9	0.7
27	Schaller	2001	2001EPSL188	WTS07026	neck-10	8.617167	48.853738	51.80	8.57	306.5	535	707.5	71.2	25.9	4.1	1.5
28	Schaller	2001	2001EPSL188	WTS07027	meu-1	5.679748	48.401438	26.63	3.41	894.8	116	432.4	37.2	33.2	2.1	1.9
29	Schaller	2001	2001EPSL188	WTS07028	meu-4	5.100368	49.535304	17.37	2.48	3994.7	254	377.4	31.4	27.0	1.8	1.5
30	Schaller	2001	2001EPSL188	WTS07029	meu-7	4.705065	49.896322	21.10	3.01	9312.2	4	385.0	17.2	1.0	1.0	0.1
31	Schaller	2001	2001EPSL188	WTS07048	loi-17	3.454769	46.074746	50.75	6.52	9037.5	1191	489.5	73.9	78.5	4.2	4.4
32	Schaller	2001	2001EPSL188	WTS07049	loi-18	3.448667	45.943636	46.54	6.43	1587.8	1357	621.0	127.5	87.6	7.2	4.9
33	Schaller	2001	2001EPSL188	WTS07050	loi-19	3.360483	45.922951	71.74	11.00	6082.6	1558	869.8	137.0	105.3	7.7	5.7
34	Schaller	2001	2001EPSL188	WTS07051	loi-21	3.648027	45.666161	37.87	6.09	764.3	1176	867.4	143.7	95.3	8.1	5.2
35	Schaller	2001	2001EPSL188	WTS07052	loi-23	3.284925	45.462028	56.81	7.87	4140.8	493	1259.3	36.5	30.4	2.1	1.7
36	Schaller	2001	2001EPSL188	WTS07053	loi-25A	3.491789	45.116778	56.23	8.43	1816.4	1059	1097.7	140.4	101.7	7.9	5.5
37	Schaller	2001	2001EPSL188	WTS07055	loi-29	3.429900	45.145681	54.85	8.54	128.5	58	1352.5	110.0	41.6	6.3	2.4
38	Schaller	2001	2001EPSL188	WTS07056	loi-36	3.861658	44.731655	40.77	6.07	257.8	354	1271.5	112.1	59.4	6.4	3.3
39	Schaller	2001	2001EPSL188	WTS07057	loi-37	3.925837	44.866696	85.95	14.26	417.8	268	1326.5	106.7	43.4	6.1	2.5
40	Schaller	2001	2001EPSL188	WTS07058	loi-39	4.212215	45.744986	75.71	11.50	5003.1	694	1014.0	99.3	48.0	5.7	2.7
41	Schaller	2001	2001EPSL188	WTS07059	loi-40	4.044567	45.997902	57.61	9.32	6640.3	9	848.5	115.7	28.8	6.6	1.6
42	Schaller	2001	2001EPSL188	WTS07061	loi-45	1.285123	47.491560	23.97	3.27	1402.1	82	135.2	18.8	10.5	1.1	0.6
43	Schaller	2001	2001EPSL188	WTS07062	loi-48	3.206198	47.138026	6.59	0.81	201.4	42	353.4	49.6	21.0	2.8	1.2
44	Schaller	2001	2001EPSL188	WTS07063	loi-49	3.206819	47.035616	13.07	1.56	557.6	273	286.4	63.1	47.2	3.6	2.7
45	Schaller	2001	2001EPSL188	WTS07064	loi-50	3.500641	46.836692	21.55	2.68	1688.4	527	453.2	65.0	41.4	3.7	2.4
46	Schaller	2001	2001EPSL188	WTS07065	loi-51	3.450358	46.771140	12.44	1.61	385.8	716	246.6	26.0	16.6	1.5	1.0
47	Schaller	2001	2001EPSL188	WTS07066	loi-52	3.683333	45.616666	28.05	3.54	753.6	1066	460.9	96.7	76.4	5.5	4.3
48	Schaller	2001	2001EPSL188	WTS07067	loi-54	3.985746	46.496142	20.32	2.75	2317.8	503	538.2	41.8	41.9	2.4	2.4
49	Schaller	2001	2001EPSL188	WTS07068	loi-55	3.314287	46.364449	36.10	4.99	2565.8	926	760.8	44.7	32.2	2.6	1.8
50	Schaller	2001	2001EPSL188	WTS07069	loi-56	3.458760	46.005835	22.20	2.96	136.0	263	346.4	36.9	34.1	2.1	1.9
51	Kirchner	2001	2001Geo29	WTS08001	1	-115.767353	44.372125	167.98	18.88	1.2	549	1748.7	280.5	108.4	15.5	5.7
52	Kirchner	2001	2001Geo29	WTS08002	2	-115.770809	44.367885	91.59	10.19	1.3	514	1689.6	271.5	109.2	15.0	5.8
53	Kirchner	2001	2001Geo29	WTS08003	3	-115.788761	44.346089	72.36	8.21	1.2	314	1580.1	208.9	78.3	11.7	4.3
54	Kirchner	2001	2001Geo29	WTS08004	4	-115.806140	44.337191	80.28	9.85	1.8	331	1604.1	257.5	93.6	14.3	5.0
55	Kirchner	2001	2001Geo29	WTS08006	6	-115.784854	44.355736	65.20	7.58	1.0	321	1567.5	222.9	86.7	12.5	4.7
56	Kirchner	2001	2001Geo29	WTS08008	8	-115.346233	45.994787	49.61	5.45	1.4	417	1551.8	288.0	86.7	16.0	4.6
57	Kirchner	2001	2001Geo29	WTS08009	9	-115.337139	45.983894	56.23	5.15	1.0	382	1536.5	228.2	67.3	12.8	3.1
58	Kirchner	2001	2001Geo29	WTS08010	10	-115.358195	45.994639	50.25	5.90	1.5	361	1534.2	225.2	75.7	12.6	4.1
59	Kirchner	2001	2001Geo29	WTS08016	16	-115.337108	45.991492	50.28	5.42	17.0	501	1586.5	250.4	117.8	13.9	6.3
60	Kirchner	2001	2001Geo29	WTS08017	17	-115.333749	45.988806	44.72	4.98	14.8	574	1603.9	276.2	108.5	15.3	5.8
61	Kirchner	2001	2001Geo29	WTS08018	18	-115.682535	45.052898	139.87	16.94	2.1	1044	1816.7	393.9	89.4	21.4	4.5
62	Kirchner	2001	2001Geo29	WTS08019	19	-115.683494	45.052806	139.81	16.46	1.6	828	1788.5	389.2	104.0	21.1	5.3
63	Kirchner	2001	2001Geo29	WTS08020	20	-115.684171	45.052688	106.78	11.81	1.4	714	1733.2	379.7	113.1	20.6	5.8
64	Kirchner	2001	2001Geo29	WTS08021	21	-115.678045	45.042886	126.01	14.23	6.4	907	1455.3	410.9	115.1	22.1	5.7
65	Kirchner	2001	2001Geo29	WTS08023	23	-115.672378	45.054504	122.17	13.80	2.5	894	1718.2	413.1	98.0	12.2	4.9
66	Kirchner	2001	2001Geo29	WTS08024	24	-115.667634	45.047037	113.28	13.02	3.7	316	1319.3	391.4	123.8	21.1	6.2
67	Kirchner	2001	2001Geo29	WTS08025	25	-115.627062	45.677493	33.32	3.66	20.5	503	1771.3	174.8	72.7	9.9	4.0
68	Kirchner	2001	2001Geo29	WTS08026	26	-115.344177	45.709344	28.05	3.54	79.6	931	1778.1	179.7	88.3	11.1	4.9
69	Kirchner	2001	2001Geo29	WTS08027	27	-115.342826	45.709986	47.15	5.15	129.6	702	1637.4	186.5	87.9	10.5	4.8
70	Kirchner	2001	2001Geo29	WTS08028	28	-115.889318	45.822955	62.14	6.67	292.9	1750	1775.7	293.9	171.6	15.9	8.6
71	Kirchner	2001	2001Geo29	WTS08029	29	-116.030710	45.887394	50.66	5.							

123	Matmon	2003	2003AmSci303	WTS10044	GSRL-2	-83.514109	35.599297	54.37	5.93	7.9	846	1421.5	343.8	101.5	18.8	5.2
124	Matmon	2003	2003AmSci303	WTS10048	GSRL-3	-83.515375	35.598316	65.36	7.36	14.6	977	1481.9	354.6	123.4	19.3	6.3
125	Matmon	2003	2003AmSci303	WTS10052	GSRL-4	-83.529218	35.616069	40.96	4.33	5.9	745	1264.2	324.2	120.8	17.7	6.2
126	Matmon	2003	2003AmSci303	WTS10053	GSRL-5	-83.539506	35.618696	30.88	3.41	29.5	905	1307.5	295.2	102.1	16.3	5.4
127	Matmon	2003	2003AmSci303	WTS10054	GSRL-6	-83.582066	35.653239	29.03	3.29	11.9	756	1118.8	285.8	111.6	15.8	5.8
128	Matmon	2003	2003AmSci303	WTS10055	GSRL-7	-83.598494	35.663819	49.35	5.44	100.5	871	982.3	290.8	125.9	16.0	6.6
129	Vance	2003	2003EPSL206	WTS11001	AK95	-79.831277	30.655866	256.81	378.69	1675.2	4867	4858.4	555.4	320.0	27.3	12.6
130	Vance	2003	2003EPSL206	WTS11002	AK82	-79.503350	30.524045	5470.85	864.41	4638.7	6421	4646.3	581.1	340.1	28.2	13.2
131	Vance	2003	2003EPSL206	WTS11004	AK124A	-78.599332	30.145829	2169.68	326.20	7640.7	6412	3501.1	517.1	250.1	26.3	10.6
132	Riebe	2003	2003GCA67	WTS12001	RI-6	-65.785621	18.275987	46.96	5.66	3.2	175	691.1	172.9	86.4	9.7	4.8
133	Riebe	2003	2003GCA67	WTS12002	RI-8	-65.795735	18.268833	78.93	9.47	4.1	487	709.7	201.2	104.2	11.3	5.6
134	Morel	2003	2003TerNov15	WTS13001	Wut4	8.222776	47.864687	120.34	20.13	38.7	481	962.3	201.8	111.9	11.3	6.0
135	Morel	2003	2003TerNov15	WTS13002	Wut5	8.218095	47.905121	42.76	6.34	1.5	341	1052.6	240.9	105.5	13.4	5.7
136	Morel	2003	2003TerNov15	WTS13003	Wut6	8.281163	47.866910	42.42	5.63	27.5	291	908.6	82.1	62.2	4.7	3.5
137	Morel	2003	2003TerNov15	WTS13004	Wut7	8.320909	47.842519	51.73	7.22	235.5	629	890.9	121.8	73.1	6.9	4.0
138	Morel	2003	2003TerNov15	WTS13005	Wut9	8.162650	47.879505	79.61	12.61	16.3	459	1037.0	177.3	102.4	9.9	5.6
139	Morel	2003	2003TerNov15	WTS13007	Wut12	8.262044	47.869038	54.64	7.79	127.0	711	986.7	190.5	109.6	10.7	5.9
140	Morel	2003	2003TerNov15	WTS13008	Wut8	8.276096	47.859065	16.84	2.02	1.5	106	834.9	62.9	29.2	3.6	1.7
141	Morel	2003	2003TerNov15	WTS13010	Wut10	8.200660	47.939091	45.51	6.68	19.6	294	990.0	194.0	87.9	10.9	4.8
142	Morel	2003	2003TerNov15	WTS13011	Wut1	8.453689	47.848231	73.85	11.48	353.0	422	789.8	86.5	78.4	4.9	4.4
143	Morel	2003	2003TerNov15	WTS13012	Don1	8.242053	47.982986	35.98	4.91	5.0	208	1056.3	150.3	69.8	8.5	3.9
144	Morel	2003	2003TerNov15	WTS13013	Don2	8.253108	47.961259	35.30	5.28	2.8	166	1068.9	140.3	47.3	8.0	2.7
145	Morel	2003	2003TerNov15	WTS13014	Don3	8.366817	47.948264	11.73	1.40	4.7	182	934.6	53.2	23.1	3.0	1.3
146	Morel	2003	2003TerNov15	WTS13015	Don4	8.366666	47.966666	12.24	1.51	2.3	130	940.0	47.7	17.0	2.7	1.0
147	vblankenburg	2004	2004IGR109	WTS14001	AO-1	80.593471	7.133057	18.82	2.34	44.8	1052	831.4	231.7	117.6	12.9	6.2
148	vblankenburg	2004	2004IGR109	WTS14002	AO-2	80.638154	7.147798	12.02	1.60	30.1	1235	1249.0	241.7	133.2	14.3	6.8
149	vblankenburg	2004	2004IGR109	WTS14003	NO-1	80.631340	7.198477	19.82	4.48	93.0	721	881.1	229.1	112.9	12.3	6.4
150	vblankenburg	2004	2004IGR109	WTS14004	NO-2	80.662779	7.153453	22.97	2.78	14.1	899	1105.7	250.0	90.8	13.9	4.8
151	vblankenburg	2004	2004IGR109	WTS14005	HUG-1	80.748284	7.312347	21.04	2.52	134.5	1376	852.1	271.3	137.3	14.9	7.0
152	vblankenburg	2004	2004IGR109	WTS14006	HUG-2	80.746572	7.374194	29.72	5.57	69.3	1323	1146.5	289.7	147.8	15.8	7.4
153	vblankenburg	2004	2004IGR109	WTS14007	MO-1	80.764707	7.193494	24.93	3.99	106.7	1519	963.7	238.5	128.3	13.2	6.6
154	vblankenburg	2004	2004IGR109	WTS14008	MO-2	80.754946	7.129532	6.58	0.73	21.0	1150	1509.2	260.6	103.0	14.5	5.5
155	vblankenburg	2004	2004IGR109	WTS14009	MO-3	80.713273	7.133333	31.13	3.68	6.1	975	1521.2	322.6	138.1	17.6	6.6
156	vblankenburg	2004	2004IGR109	WTS14010	BO-1	80.835600	7.144473	50.24	7.48	146.7	1828	1171.9	285.0	141.1	15.6	7.2
157	vblankenburg	2004	2004IGR109	WTS14011	BO-2	80.798108	7.092724	34.15	4.33	74.2	1843	1533.6	359.8	205.7	19.1	9.4
158	vblankenburg	2004	2004IGR109	WTS14012	UO-1	80.943169	7.138472	25.14	3.66	730.8	2187	1162.4	250.2	151.2	13.7	7.8
159	vblankenburg	2004	2004IGR109	WTS14013	UO-2	80.908112	6.907010	19.94	4.48	40.7	1318	1416.1	187.9	122.5	10.5	6.5
160	vblankenburg	2004	2004IGR109	WTS14014	UO-3	80.851670	6.930427	36.43	6.22	42.0	1350	1871.1	221.6	158.2	12.2	8.1
161	vblankenburg	2004	2004IGR109	WTS14015	M-PER	80.595104	7.260614	15.84	1.90	1071.0	2038	1245.0	221.5	142.4	12.2	7.3
162	vblankenburg	2004	2004IGR109	WTS14016	M-HAG	80.702941	7.269045	28.00	3.48	1410.1	1637	579.8	144.9	110.7	8.1	5.9
163	vblankenburg	2004	2004IGR109	WTS14017	M-VIC	80.786607	7.239065	59.06	8.54	1898.7	1881	687.3	219.7	148.9	12.1	7.9
164	vblankenburg	2004	2004IGR109	WTS14018	M-MIN	80.980672	7.210545	28.81	3.61	3130.1	2180	605.1	294.5	169.7	16.0	8.6
165	Nichols	2005	2005BookChapter	WTS15001	CCC	-79.324874	9.359510	13.26	1.60	61.3	320	414.5	190.0	76.6	10.7	4.2
166	Nichols	2005	2005BookChapter	WTS15002	ChC	-79.506469	9.266866	18.05	2.32	406.6	606	243.6	230.6	101.2	12.9	5.5
167	Nichols	2005	2005BookChapter	WTS15004	CHAG-7	-79.352417	9.331197	7.90	1.21	1.0	307	468.4	271.2	102.9	15.0	5.5
168	Nichols	2005	2005BookChapter	WTS15005	CHAG-9	-79.272359	9.363369	17.18	2.14	4.1	401	632.1	198.2	96.9	11.1	5.2
169	Nichols	2005	2005BookChapter	WTS15006	CHAG-12	-79.271742	9.368299	10.31	1.29	1.3	155	527.7	169.6	62.8	9.6	3.5
170	Nichols	2005	2005BookChapter	WTS15007	CHAG-14	-79.261047	9.370643	7.15	0.89	5.3	244	545.8	129.4	61.3	7.3	3.4
171	Nichols	2005	2005BookChapter	WTS15008	CHAG-15	-79.263076	9.369111	13.86	1.67	3.4	244	556.6	151.5	60.8	8.6	3.4
172	Nichols	2005	2005BookChapter	WTS15009	CHAG-17	-79.411323	9.295804	11.81	1.53	176.0	577	423.9	213.3	94.1	11.9	5.1
173	Nichols	2005	2005BookChapter	WTS15010	CHAG-19	-79.505269	9.269348	14.00	1.96	364.2	744	410.4	252.8	111.6	14.0	5.9
174	Nichols	2005	2005BookChapter	WTS15011	Chico	-79.506521	9.270825	15.99	2.33	40.9	640	427.0	247.4	121.3	13.7	6.4
175	Nichols	2005	2005BookChapter	WTS15012	CHM-1	-79.320718	9.359500	10.59	1.29	34.9	448	517.0	182.0	88.5	10.2	4.8
176	Nichols	2005	2005BookChapter	WTS15014	CLA	-79.531062	9.243797	15.28	1.89	461.1	850	379.4	209.7	98.1	11.7	5.3
177	Nichols	2005	2005BookChapter	WTS15015	CPC	-79.416250	9.294182	14.36	1.81	277.3	766	373.3	231.3	106.9	12.9	5.8
178	Nichols	2005	2005BookChapter	WTS15016	CTOM	-79.322502	9.365270	12.86	1.63	24.1	368	483.0	162.5	77.9	9.2	4.1
179	Nichols	2005	2005BookChapter	WTS15017	PIED	-79.411394	9.329551	15.25	1.78	92.9	820	553.5	270.0	95.9	13.2	5.1
180	Bierman	2005	2005ESPL30	WTS16001	RP-3	-106.890438	34.575404	19.23	1.89	40.7	878	1796.7	319.6	122.7	12.2	4.1
181	Bierman	2005	2005ESPL30	WTS16006	RP-6	-107.032657	34.887340	80.22	8.82	7122.1	1221	1928.3	68.1	76.0	3.9	4.2
182	Bierman	2005	2005ESPL30	WTS16007	RP-7	-107.028106	34.891980	123.75	13.91	7079.7	475	1709.7	49.6	50.1	2.8	2.8
183	Bierman	2005	2005ESPL30	WTS16008	RP-8	-107.338672	35.038911	63.32	6.91	5107.1	738	1815.6	66.2	71.8	3.8	4.0
184	Bierman	2005	2005ESPL30	WTS16009	RP-9	-107.322913	35.093115	160.49	19.42	310.0	1485	2332.9	92.9	93.7	5.2	5.1
185	Bierman	2005	2005ESPL30	WTS16010	RP-10	-107.344209	35.068014	53.37	6.16	4746.6	1675	2184.5	86.0	94.5	4.8	5.2
186	Bierman	2005	2005ESPL30	WTS16011	RP-14A	-108.011380	35.355175	56.26	6.31	745.0	596	2198.4	64.1	75.4	3.6	4.1
187	Bierman	2005	2005ESPL30	WTS16012	RP-14B	-108.009978	35.350083	63.97	7.13	747.5	154	2115.8	46.8	23.2	2.7	1.3
188	Bierman	2005	2005ESPL30	WTS16013	RP-18	-108.213680	35.342022	7.59	0.85	190.9	496	2463.4	80.2	71.2	4.6	3.9
189	Bierman	2005	2005ESPL30	WTS16014	RP-19	-106.942411	35.033766	143.94	16.31	6596.2	681	1776.4	50.5	44.9	2.9	2.5
190	Bierman	2005	2005ESPL30	WTS16015	RP-20	-107.034834	35.335747	134.55	14.76	302.8	2079	2079.1	111.4	96.9	6.3	5.3
191	Bierman	2005	2005ESPL30	WTS16016	RP-42	-107.043430	35.347824	185.18	24.28	471.3	341	2086.7	36.4	27.0	2.1	1.8
192	Bierman	2005	2005ESPL30	WTS16017	RP-22	-107.167751	35.570926	134.16	15.13	4737.7	1045	2125.8	107.1	92.7	6.0	5.1
193	Bierman	2005	2005ESPL30	WTS16018	RP-23	-107.179583	35.598648	178.34	20.65	1117.0	1109	2115.7	103.9	102.2	5.8	5.6
194	Bierman	2005	2005ESPL30	WTS16019	RP-24	-106.985794	35.924690	263.16	31.47	538.0	1					

251	Safran	2005	2005ESPL30	WTS18039	BOL-36a	-67.228386	-16.751776	224.72	26.27	21.4	1847	2794.4	589.0	190.3	29.9	8.3
252	Safran	2005	2005ESPL30	WTS18041	BOL-37	-67.335355	-16.553169	477.11	54.10	845.2	4559	3268.7	525.9	219.1	26.9	9.6
253	Safran	2005	2005ESPL30	WTS18042	BOL-38a	-67.398294	-16.550337	529.66	60.46	5440.4	5264	3635.0	406.5	207.4	21.4	9.8
254	Safran	2005	2005ESPL30	WTS18044	BOL-39	-67.467341	-16.428654	145.61	16.76	69.1	2352	2102.9	450.2	197.2	23.6	8.8
255	Safran	2005	2005ESPL30	WTS18045	BOL-40	-67.481896	-16.418810	324.34	39.70	153.9	3091	2528.6	521.3	188.2	26.9	8.2
256	Safran	2005	2005ESPL30	WTS18046	BOL-41	-67.432037	-16.319499	1165.33	155.07	1468.0	2912	1944.4	495.3	190.4	25.7	8.6
257	Safran	2005	2005ESPL30	WTS18048	BOL-43	-67.432872	-16.322825	304.74	37.43	418.8	3296	2161.5	484.4	181.6	25.3	8.2
258	Safran	2005	2005ESPL30	WTS18049	BOL-44	-67.645811	-16.404941	628.83	76.52	602.7	5090	3693.9	631.7	323.8	30.6	11.5
259	Safran	2005	2005ESPL30	WTS18050	BOL-45	-67.642389	-16.401593	810.72	107.27	353.9	3520	2713.8	637.9	286.6	31.2	10.0
260	Safran	2005	2005ESPL30	WTS18051	BOL-46a	-67.800894	-16.356875	382.71	48.43	23.2	2989	3746.7	580.2	289.5	28.7	10.9
261	Safran	2005	2005ESPL30	WTS18054	BOL-48	-67.909029	-16.313351	701.82	80.34	63.2	1907	4257.1	614.1	395.6	29.1	14.2
262	Safran	2005	2005ESPL30	WTS18055	BOL-49	-67.888380	-16.310749	424.14	47.49	61.3	2843	4227.9	677.1	459.8	31.0	14.6
263	Reuter	2005	2005MSCThesis	WTS19001	JSQ1	-76.753112	39.944823	27.15	3.13	573.4	304	214.5	74.5	46.6	4.3	2.6
264	Reuter	2005	2005MSCThesis	WTS19002	JSQ2	-76.720097	40.081700	18.33	2.09	1326.2	495	191.6	51.4	48.5	2.9	2.7
265	Reuter	2005	2005MSCThesis	WTS19003	JSQ3	-76.898022	40.224508	25.19	2.81	558.5	551	250.6	81.3	72.8	4.6	4.1
266	Reuter	2005	2005MSCThesis	WTS19005	JSQ5	-77.168530	40.323140	13.89	1.54	535.0	557	315.9	138.1	101.4	7.8	5.6
267	Reuter	2005	2005MSCThesis	WTS19006	JSQ6	-77.402213	40.370981	9.35	1.14	38.8	418	277.7	111.3	93.3	6.3	5.1
268	Reuter	2005	2005MSCThesis	WTS19007	JSQ7	-77.128783	40.478493	24.19	2.75	8685.9	838	361.7	136.1	107.2	7.6	5.9
269	Reuter	2005	2005MSCThesis	WTS19008	JSQ9	-77.794296	40.890641	16.59	1.89	224.3	491	394.1	80.6	82.1	4.6	4.5
270	Reuter	2005	2005MSCThesis	WTS19009	JSQ10	-77.778493	40.943411	20.79	2.29	690.1	549	412.2	149.6	103.8	8.4	5.7
271	Reuter	2005	2005MSCThesis	WTS19010	JSQ11	-78.675563	40.901478	24.22	2.73	815.8	338	526.9	105.4	67.3	6.0	3.8
272	Reuter	2005	2005MSCThesis	WTS19011	JSQ12	-78.264893	40.216683	11.16	1.26	1955.2	673	454.0	128.8	97.7	7.3	5.4
273	Reuter	2005	2005MSCThesis	WTS19012	JSQ13	-78.492517	40.071497	10.84	1.21	445.2	626	486.1	125.0	88.9	7.1	4.9
274	Reuter	2005	2005MSCThesis	WTS19013	JSQ39	-76.577030	40.403004	17.69	2.01	870.2	414	234.3	87.4	79.6	5.0	4.4
275	Reuter	2005	2005MSCThesis	WTS19014	JS42	-76.368082	39.946487	24.41	2.79	1211.8	345	151.9	54.9	46.1	3.1	2.6
276	Reuter	2005	2005MSCThesis	WTS19015	JS43	-76.277217	40.018317	14.13	1.58	140.7	256	138.3	34.9	31.6	2.0	1.8
277	Reuter	2005	2005MSCThesis	WTS19016	JS44	-75.989059	40.114609	13.29	1.49	6.1	153	15.1	48.1	34.2	1.5	1.3
278	Reuter	2005	2005MSCThesis	WTS19017	JS45	-76.328295	39.905942	26.07	2.86	381.8	271	157.6	56.0	41.8	3.2	2.4
279	Reuter	2005	2005MSCThesis	WTS19020	JSQ29	-76.634392	42.002955	87.82	11.13	6507.0	502	481.9	116.0	85.2	6.6	4.7
280	Reuter	2005	2005MSCThesis	WTS19021	JSQ30	-77.131679	42.028690	75.45	12.98	1986.1	492	527.3	134.2	88.1	7.6	4.9
281	Reuter	2005	2005MSCThesis	WTS19022	JSQ31	-77.131272	41.909249	51.08	6.83	722.7	433	541.6	116.9	84.8	6.6	4.7
282	Reuter	2005	2005MSCThesis	WTS19023	JSQ32	-77.014700	41.790609	92.75	21.42	31.5	337	542.2	118.1	78.2	6.7	4.4
283	Reuter	2005	2005MSCThesis	WTS19024	JSQ33	-76.965182	41.815121	89.82	16.10	26.1	319	558.3	123.6	76.4	7.0	4.3
284	Reuter	2005	2005MSCThesis	WTS19026	JSQ35	-75.897289	41.555511	99.30	11.61	1012.3	630	408.3	109.1	71.1	6.2	4.0
285	Reuter	2005	2005MSCThesis	WTS19027	JSQ100	-78.153555	41.375843	32.34	4.18	3.0	534	524.9	306.6	139.4	16.8	7.3
286	Reuter	2005	2005MSCThesis	WTS19028	JSQ101	-78.196244	41.413665	27.37	3.12	705.0	467	544.0	200.3	126.8	11.2	6.8
287	Reuter	2005	2005MSCThesis	WTS19029	JSQ102	-78.152894	41.458532	70.45	9.13	3.2	344	298.8	29.3	16.2	16.2	8.6
288	Reuter	2005	2005MSCThesis	WTS19030	JSQ103	-78.186561	41.592175	42.19	5.16	5.6	324	570.9	261.7	117.0	14.5	6.2
289	Reuter	2005	2005MSCThesis	WTS19031	JSQ104	-78.037510	41.704190	39.46	4.65	3.5	186	630.7	129.6	67.8	7.4	3.8
290	Reuter	2005	2005MSCThesis	WTS19032	JSQ105	-78.429866	41.458844	23.05	2.61	3.2	75	614.1	60.8	29.5	3.5	1.7
291	Reuter	2005	2005MSCThesis	WTS19033	JSQ106	-78.359307	41.448276	27.89	3.13	3.2	174	597.3	175.5	75.1	9.9	4.2
292	Reuter	2005	2005MSCThesis	WTS19034	JSQ107	-78.359213	41.427358	44.84	5.32	3.4	252	567.3	196.9	71.6	11.1	4.0
293	Reuter	2005	2005MSCThesis	WTS19035	JSQ108	-78.356925	41.395805	17.91	1.99	5.4	196	621.6	115.6	53.7	6.6	3.0
294	Reuter	2005	2005MSCThesis	WTS19036	JSQ109	-78.103735	41.598118	50.98	6.47	3.2	259	638.1	276.0	107.0	15.3	5.7
295	Reuter	2005	2005MSCThesis	WTS19037	JSQ110	-77.976035	41.452514	10.69	1.20	1.3	59	610.3	46.4	20.7	2.7	1.2
296	Reuter	2005	2005MSCThesis	WTS19039	JSQ112	-77.949184	41.385906	49.77	6.04	3.5	299	502.9	214.6	86.0	12.0	4.7
297	Reuter	2005	2005MSCThesis	WTS19040	JSQ113	-77.968934	41.358322	24.26	2.61	3.9	200	536.8	167.4	70.2	9.5	3.9
298	Reuter	2005	2005MSCThesis	WTS19041	JSQ114	-78.278100	41.244609	13.29	1.49	6.1	153	628.9	15.4	37.8	2.4	1.0
299	Reuter	2005	2005MSCThesis	WTS19042	JSQ115	-78.233381	41.275617	17.78	1.97	4.8	175	622.2	89.1	91.2	5.0	5.1
300	Reuter	2005	2005MSCThesis	WTS19043	JSQ116	-78.038751	41.203619	15.46	1.76	6.5	219	543.5	70.6	31.5	4.0	1.8
301	Reuter	2005	2005MSCThesis	WTS19044	JSQ117	-78.033936	41.204583	15.14	1.66	3.4	141	499.0	60.3	24.1	3.5	1.4
302	Reuter	2005	2005MSCThesis	WTS19045	JSQ118	-77.789435	41.285748	26.24	2.99	4.0	352	591.2	213.3	167.2	11.7	8.8
303	Reuter	2005	2005MSCThesis	WTS19046	JSQ119	-77.767760	41.274332	42.72	5.06	5.3	304	570.9	288.6	119.1	15.9	6.2
304	Reuter	2005	2005MSCThesis	WTS19047	JSQ120	-77.921340	41.208882	25.61	2.93	15.1	370	609.2	161.6	169.8	8.9	8.9
305	Reuter	2005	2005MSCThesis	WTS19049	JSQ123	-77.797565	41.203146	11.79	1.27	3.1	111	643.9	81.1	38.5	4.6	2.2
306	Reuter	2005	2005MSCThesis	WTS19050	JSQ124	-77.340370	41.205534	12.43	1.49	2.7	130	293.8	125.0	60.8	7.1	3.4
307	Reuter	2005	2005MSCThesis	WTS19051	JSQ125	-77.246073	41.097687	29.79	3.40	9.7	178	519.8	87.0	56.1	5.0	3.1
308	Reuter	2005	2005MSCThesis	WTS19052	JSQ126	-77.274594	41.085208	21.26	2.28	3.1	76	518.5	22.7	12.8	30.8	3.0
309	Reuter	2005	2005MSCThesis	WTS19053	JSQ127	-77.307830	41.069170	10.75	1.20	5.5	96	556.5	59.7	26.3	3.4	1.5
310	Reuter	2005	2005MSCThesis	WTS19054	JSQ128	-77.118859	41.074729	17.17	1.85	3.2	181	521.5	132.9	64.0	7.5	3.6
311	Reuter	2005	2005MSCThesis	WTS19055	JSQ129	-77.222753	40.940345	7.64	0.82	3.1	100	622.6	59.2	33.0	3.4	1.9
312	Reuter	2005	2005MSCThesis	WTS19056	JSQ130	-76.611729	41.074138	14.59	1.65	6.4	97	199.1	43.7	25.0	2.5	1.4
313	Reuter	2005	2005MSCThesis	WTS19057	JSQ131	-76.522073	41.075418	19.72	2.36	5.2	137	279.5	108.5	54.8	6.2	3.1
314	Reuter	2005	2005MSCThesis	WTS19058	JSQ132	-76.716420	40.851677	8.02	0.89	3.8	95	206.0	60.7	41.4	3.5	2.4
315	Reuter	2005	2005MSCThesis	WTS19059	JSQ133	-76.746340	40.522252	10.20	1.08	3.0	118	494.7	58.6	26.4	3.4	1.5
316	Reuter	2005	2005MSCThesis	WTS19060	JSQ134	-76.897657	40.686039	20.45	2.37	5.6	105	206.9	79.9	41.6	4.6	2.4
317	Reuter	2005	2005MSCThesis	WTS19061	JSQ135	-76.956446	40.624969	24.83	2.74	4.0	148	218.5	107.1	63.9	6.1	3.6
318	Reuter	2005	2005MSCThesis	WTS19062	JSQ136	-77.655656	40.368801	17.51	1.90	3.3	99	835.8	36.5	21.8	36.5	2.1
319	Reuter	2005	2005MSCThesis	WTS19063	JSQ137	-77.609774	40.530273	14.82	1.50	2.8	148	561.2	20.7	16.8	11.6	5.3
320	Reuter	2005	2005MSCThesis	WTS19064	JSQ138	-77.609124	40.531040	18.50	2.13	3.8	273	428.4	210.2	98.3	11.8	5.3
321	Reuter	2005	2005MSCThesis	WTS19065	JSQ139	-77.766085	40.407224	29.35	3.25	3.2	285	515.3	249.4	120.1	13.8	6.4
322	Reuter	2005	2005MSCThesis	WTS19066	JSQ140	-78.048443	40.326468	8.74	0.98							

379	Binnie	2007	2007GeoI35	WTS26009	9	-116.951371	34.185789	573.44	75.31	2.9	738	2125.8	372.8	196.7	19.8	9.8
380	Binnie	2007	2007GeoI35	WTS26010	10	-117.015431	34.212077	187.84	23.34	3.1	812	1974.3	484.5	166.3	25.4	8.0
381	Binnie	2007	2007GeoI35	WTS26011	11	-117.043797	34.170293	1655.64	324.40	4.1	1212	1820.8	483.8	141.6	25.5	6.8
382	Binnie	2007	2007GeoI35	WTS26012	12	-116.935146	34.195653	249.78	29.34	1.6	597	2142.5	446.7	172.2	23.6	8.4
383	Binnie	2007	2007GeoI35	WTS26013	13	-116.928661	34.193864	308.14	35.74	1.4	664	2136.1	417.6	150.9	22.3	7.5
384	Binnie	2007	2007GeoI35	WTS26014	14	-117.054805	34.203989	110.20	13.71	1.3	437	1668.9	214.5	89.8	12.0	4.8
385	Binnie	2007	2007GeoI35	WTS26015	15	-117.075616	34.396673	94.92	11.97	1.9	322	1548.7	224.8	120.3	12.5	6.4
386	Binnie	2007	2007GeoI35	WTS26016	16	-117.032489	34.276754	163.68	19.18	2.3	702	2205.5	314.5	110.5	17.3	5.7
387	Binnie	2007	2007GeoI35	WTS26017	17	-117.056033	34.284158	105.15	12.37	7.9	468	1924.9	169.7	101.6	9.5	5.5
388	Binnie	2007	2007GeoI35	WTS26018	18	-117.043854	34.279446	76.01	9.38	8.2	575	1972.7	112.1	63.2	6.4	3.5
389	Binnie	2007	2007GeoI35	WTS26019	19	-117.062615	34.402745	138.69	18.01	6.1	912	1691.4	224.4	134.4	12.4	7.0
390	Binnie	2007	2007GeoI35	WTS26020	20	-117.090225	34.357776	57.28	6.70	7.6	710	1808.2	111.6	78.5	6.3	4.4
391	Vanacker	2007	2007GeoI35	WTS27003	RGSTER	-78.897316	-2.961784	26.76	2.93	20.2	148	2919.0	174.5	131.4	9.7	7.3
392	Vanacker	2007	2007GeoI35	WTS27004	RG2	-78.911738	-2.935872	59.57	7.14	29.3	722	2973.3	208.0	88.0	11.7	4.8
393	Vanacker	2007	2007GeoI35	WTS27007	MAR	-78.950920	-3.044116	28.76	3.23	49.8	244	3067.0	225.7	90.0	12.6	5.4
394	Vanacker	2007	2007GeoI35	WTS27008	BQ	-78.932120	-2.936543	50.94	6.14	140.7	724	2910.6	236.4	113.4	13.1	6.0
395	Vanacker	2007	2007GeoI35	WTS27009	QU	-78.920804	-2.981351	75.25	9.43	16.9	170	3056.8	298.8	70.5	16.6	3.7
396	Vanacker	2007	2007GeoI35	WTS27010	IAZ(1)	-78.881851	-2.875637	48.22	5.77	276.3	854	2849.9	220.4	116.0	12.3	6.1
397	Vanacker	2007	2007GeoI35	WTS27012	CJ	-78.872654	-2.920149	92.58	12.76	19.5	518	2966.0	160.9	63.0	9.1	3.5
398	Vanacker	2007	2007GeoI35	WTS27013	DE2	-78.922822	-2.767948	101.35	11.85	39.0	1118	3145.3	206.5	99.4	11.6	5.4
399	Vanacker	2007	2007GeoI35	WTS27014	SIS	-78.808337	-2.991794	3.59	0.41	8.4	906	2843.9	280.5	130.8	15.4	6.8
400	Vanacker	2007	2007GeoI35	WTS27015	RGD(1)	-78.800556	-2.942590	27.53	3.19	2.2	650	2721.7	325.0	90.8	17.9	4.7
401	Reinhardt	2007	2007JGeophysResI12	WTS28003	MRS14	-3.489817	37.002233	1736.38	247.11	8.3	1301	2294.2	384.7	111.0	20.8	5.5
402	Reinhardt	2007	2007JGeophysResI12	WTS28004	MRS15B	-3.493582	36.999183	1845.21	289.69	1.4	983	2098.9	328.9	109.9	18.0	5.6
403	Reinhardt	2007	2007JGeophysResI12	WTS28005	MRS17	-3.507711	36.990017	937.20	114.65	3.0	1186	1953.3	365.8	109.3	19.9	5.5
404	Reinhardt	2007	2007JGeophysResI12	WTS28007	MRS21A	-3.507722	36.991534	1189.54	330.29	14.0	827	1715.6	364.1	163.4	19.6	7.9
405	Reinhardt	2007	2007JGeophysResI12	WTS28008	MRS21B	-3.512431	36.988479	1587.26	440.85	17.3	838	1327.8	394.5	218.5	21.4	9.1
406	Wittmann	2007	2007JGR112	WTS29001	Anza	8.262312	46.022889	946.36	31.91	256.5	4287	1781.7	615.5	231.2	30.7	9.5
407	Wittmann	2007	2007JGR112	WTS29002	Buetsch-1	7.412396	46.847306	121.93	24.72	12.2	228	839.2	185.4	86.5	10.4	4.7
408	Wittmann	2007	2007JGR112	WTS29003	Buetsch-2	7.429769	46.844579	107.31	16.60	8.3	279	908.8	164.3	86.1	9.3	4.7
409	Wittmann	2007	2007JGR112	WTS29004	Chie	8.301650	46.504194	980.96	258.53	154.3	2218	2365.2	456.4	225.9	23.7	10.4
410	Wittmann	2007	2007JGR112	WTS29005	Emme	7.636110	47.032608	265.25	42.06	680.0	1618	984.5	242.8	155.7	13.3	7.8
411	Wittmann	2007	2007JGR112	WTS29006	Furka	8.492048	46.586771	1623.62	343.47	27.6	1835	2496.8	445.2	182.6	23.4	8.4
412	Wittmann	2007	2007JGR112	WTS29007	Gren	8.099770	46.372263	1516.89	511.41	5.8	1755	2017.7	604.5	240.8	30.1	10.4
413	Wittmann	2007	2007JGR112	WTS29008	Klem-a	8.220107	47.046973	477.89	120.72	444.6	1777	1074.5	283.2	182.3	15.3	8.9
414	Wittmann	2007	2007JGR112	WTS29010	Lona	7.785528	46.402976	1999.81	548.29	103.0	2455	2542.9	560.1	261.5	28.1	10.8
415	Wittmann	2007	2007JGR112	WTS29011	Mag1	8.735457	46.247078	359.22	10.77	10.7	1846	545.7	406.0	205.6	28.1	5.7
416	Wittmann	2007	2007JGR112	WTS29012	Mag10	8.667499	46.389661	809.44	164.15	29.6	2234	1975.7	656.4	266.0	32.1	10.3
417	Wittmann	2007	2007JGR112	WTS29013	Mag11-2	8.622410	46.297068	825.17	162.09	450.1	2347	1607.8	600.8	287.4	29.6	11.2
418	Wittmann	2007	2007JGR112	WTS29014	Mag11-4	8.713289	46.240970	852.95	169.10	542.9	2027	1276.6	604.6	253.1	30.1	10.7
419	Wittmann	2007	2007JGR112	WTS29015	Mag13	8.526237	46.448490	792.43	162.41	10.1	832	2512.1	427.2	209.8	22.4	9.8
420	Wittmann	2007	2007JGR112	WTS29016	Mag16	8.652433	46.399504	1125.44	311.17	120.9	2130	1972.2	551.2	238.4	27.9	10.0
421	Wittmann	2007	2007JGR112	WTS29017	Mag17	8.638787	46.409844	375.35	66.26	46.0	2005	1980.5	581.2	265.8	28.9	10.7
422	Wittmann	2007	2007JGR112	WTS29018	Mag18	8.667139	46.448987	635.01	107.53	6.8	1265	2131.3	510.9	231.2	26.1	10.1
423	Wittmann	2007	2007JGR112	WTS29019	Mag2	8.706109	46.251334	363.74	71.22	18.3	1914	1425.3	631.1	181.9	31.7	7.6
424	Wittmann	2007	2007JGR112	WTS29020	Mag4	8.546785	46.299265	1113.19	308.98	65.8	1925	1833.2	637.6	265.9	27.0	10.6
425	Wittmann	2007	2007JGR112	WTS29021	Mag8	8.607107	46.342501	909.57	204.44	120.9	2777	1890.6	655.1	326.5	31.4	12.4
426	Wittmann	2007	2007JGR112	WTS29022	Mela1	8.574420	46.138688	1279.27	298.63	106.0	1798	1552.0	465.3	190.5	24.3	9.1
427	Wittmann	2007	2007JGR112	WTS29023	Mela2	8.696556	46.174181	1060.98	419.06	166.0	2087	1233.9	494.2	202.0	25.6	9.2
428	Wittmann	2007	2007JGR112	WTS29024	Mela3a	8.715736	46.181152	614.14	150.89	317.4	2245	1339.9	522.2	200.5	26.9	8.9
429	Wittmann	2007	2007JGR112	WTS29026	Reuss-a	8.640961	46.839462	1780.99	693.10	670.4	3130	2100.9	564.6	262.5	28.3	11.0
430	Wittmann	2007	2007JGR112	WTS29028	Sense	7.320947	46.822271	292.78	63.59	161.5	1480	1292.7	315.5	187.4	17.0	9.0
431	Wittmann	2007	2007JGR112	WTS29029	Sesia	8.259461	45.810757	525.37	115.35	618.4	4023	1600.5	569.0	218.9	28.8	9.3
432	Wittmann	2007	2007JGR112	WTS29030	Taf	7.289018	46.875190	174.35	28.51	38.0	315	700.3	103.0	72.7	5.8	4.1
433	Wittmann	2007	2007JGR112	WTS29031	Tic-a	8.559282	46.519319	923.26	223.65	78.9	1841	2179.9	483.7	207.5	25.1	9.4
434	Wittmann	2007	2007JGR112	WTS29033	Toce-a	8.535026	46.176547	1300.27	303.16	360.4	2976	1938.9	532.9	272.0	26.8	11.7
435	Wittmann	2007	2007JGR112	WTS29035	Verz-a	8.843657	46.251111	621.77	140.05	184.6	2336	1662.8	689.7	263.5	33.4	10.2
436	Wittmann	2007	2007JGR112	WTS29037	Wassen1-1	7.818142	47.022277	397.76	71.05	11.7	496	1046.2	307.5	106.6	10.9	5.7
437	Binnie	2008	2008GPSL276	WTS29002	KC	-116.962734	34.160188	660.43	81.76	1.5	871	2048.1	390.8	105.5	21.2	5.3
438	Codilean	2008	2008GeoI36	WTS31001	N2C	16.231486	-23.484712	18.02	2.05	45.8	887	1564.8	212.7	166.9	11.7	8.7
439	Codilean	2008	2008GeoI36	WTS31002	N2G	16.313166	-23.469645	15.75	1.75	91.5	980	1618.8	204.6	153.4	11.3	8.0
440	Codilean	2008	2008GeoI36	WTS31003	N3E	16.419892	-23.342974	6.29	0.70	48.4	185	1834.7	43.2	18.3	2.5	1.1
441	Codilean	2008	2008GeoI36	WTS31004	N3F	16.344922	-23.325474	9.59	1.08	78.2	582	1866.6	90.3	124.0	5.0	6.7
442	Norton	2008	2008GeoMorph95	WTS32001	FON1	8.061989	47.030380	304.57	47.05	62.5	723	880.7	287.2	135.8	15.8	6.9
443	Norton	2008	2008GeoMorph95	WTS32002	FON2	8.032105	47.037052	377.36	58.39	4.6	345	905.9	254.6	91.3	14.2	4.9
444	Norton	2008	2008GeoMorph95	WTS32003	FON3	7.981158	47.030459	310.90	48.10	3.5	513	1000.8	256.2	94.4	14.3	5.1
445	Norton	2008	2008GeoMorph95	WTS32004	FON4	7.986290	46.972048	380.13	60.74	5.8	332	1018.2	232.0	84.6	13.0	4.6
446	Norton	2008	2008GeoMorph95	WTS32005	FON5	7.966169	46.970220	401.53	5.25	3.5	323	1080.5	298.0	114.9	16.4	6.0
447	Norton	2008	2008GeoMorph95	WTS32006	FON6	7.970820	46.987051	653.39	166.78	2.4	338	1078.9	305.4	105.7	15.6	6.8
448	Norton	2008	2008GeoMorph95	WTS32009	FON7	8.001204	46.982830	465.71	70.17	12.0	531	1045.6	317.3	123.6	17.4	6.4
449	Norton	2008	2008GeoMorph95	WTS32010	TRUB1	7.892955	46.995373	363.06	56.37	1.						

507	Ouimet	2009	2009GeoI37	WTS37027	wbo529	102.059572	30.104716	651.35	81.35	7.0	2321	3823.2	689.2	190.6	33.9	7.8
508	Ouimet	2009	2009GeoI37	WTS37028	wbo530	102.073183	30.078696	503.40	59.66	14.2	3611	3737.6	768.7	247.6	36.5	8.9
509	Ouimet	2009	2009GeoI37	WTS37029	wbo536	100.983463	30.041914	106.73	12.44	78.8	1912	3795.2	533.5	161.8	27.6	7.4
510	Ouimet	2009	2009GeoI37	WTS37030	wbo538	101.219967	30.040163	101.82	11.05	43.5	1506	4046.9	497.2	175.3	25.9	8.2
511	Ouimet	2009	2009GeoI37	WTS37031	wbo544	101.588417	29.979858	48.97	5.24	61.7	1167	3963.1	396.1	174.9	21.1	8.7
512	Ouimet	2009	2009GeoI37	WTS37032	wbo545	101.521414	30.330009	24.19	2.64	16.5	468	3914.3	273.1	113.8	15.1	6.0
513	Ouimet	2009	2009GeoI37	WTS37033	wbo549	102.110215	29.654313	3232.50	413.34	71.8	5030	4205.3	553.2	260.6	27.8	11.5
514	Ouimet	2009	2009GeoI37	WTS37034	wbo550	102.139929	29.540076	1323.55	211.26	27.3	2850	2590.4	714.1	253.9	34.5	8.9
515	Ouimet	2009	2009GeoI37	WTS37035	wbo551	102.250173	29.342945	185.91	25.38	75.8	3544	2428.7	580.2	237.8	29.2	9.5
516	Ouimet	2009	2009GeoI37	WTS37036	wbo604	103.273396	32.018235	318.88	36.90	99.0	2636	3353.0	619.9	196.4	31.1	8.3
517	Ouimet	2009	2009GeoI37	WTS37037	wbo605	102.894405	32.129778	305.26	33.79	11.5	1567	3548.4	547.4	149.8	28.3	6.8
518	Ouimet	2009	2009GeoI37	WTS37038	wbo607	102.494892	32.269269	218.36	23.52	16.6	831	4005.0	373.7	128.0	20.2	6.5
519	Ouimet	2009	2009GeoI37	WTS37039	wbo609	100.810971	32.419087	181.92	19.73	41.9	1145	4189.9	431.2	157.9	22.9	7.7
520	Ouimet	2009	2009GeoI37	WTS37040	wbo610q	100.670352	32.529886	120.11	13.61	46.7	989	4141.1	408.8	138.0	21.9	6.8
521	Ouimet	2009	2009GeoI37	WTS37042	wbo612	100.387943	32.220212	65.09	7.43	38.3	753	4242.1	290.8	103.2	16.1	5.5
522	Ouimet	2009	2009GeoI37	WTS37043	wbo613	101.186921	32.618395	123.73	13.28	36.4	1546	4144.7	486.0	178.1	25.4	8.3
523	Ouimet	2009	2009GeoI37	WTS37044	wbo614	101.080376	32.577625	138.81	15.46	15.5	1182	3945.3	435.9	125.6	23.3	6.1
524	Ouimet	2009	2009GeoI37	WTS37045	wbo616	101.050024	32.432401	177.22	19.70	76.1	1057	3818.8	340.0	138.6	18.5	7.1
525	Ouimet	2009	2009GeoI37	WTS37046	wbo617	101.221178	32.340400	77.96	8.33	29.5	960	3936.5	347.8	129.5	18.9	6.6
526	Ouimet	2009	2009GeoI37	WTS37047	wbo618	100.719948	31.450024	118.50	13.03	43.7	1325	3979.8	466.4	157.8	24.6	7.5
527	Ouimet	2009	2009GeoI37	WTS37048	wbo619	101.075998	31.026159	241.62	27.09	58.3	1801	3973.1	444.2	168.4	23.5	8.1
528	Ouimet	2009	2009GeoI37	WTS37049	wbo621	101.379300	30.319768	51.40	5.80	62.5	528	4270.3	123.5	78.9	7.0	4.4
529	Ouimet	2009	2009GeoI37	WTS37050	wbo622	101.421057	30.308957	73.80	7.80	3.1	278	4253.2	160.0	74.0	9.0	4.1
530	Ouimet	2009	2009GeoI37	WTS37051	wbo623	101.509674	30.142286	47.71	4.89	12.3	666	3810.0	385.9	128.6	20.8	6.5
531	Ouimet	2009	2009GeoI37	WTS37052	wbo624q	101.094988	29.767808	139.24	15.25	53.7	2241	3829.7	527.8	173.7	27.3	8.1
532	Ouimet	2009	2009GeoI37	WTS37054	wbo625	101.306677	30.049807	128.26	13.82	5.4	783	4260.9	401.0	155.3	21.5	7.7
533	Ouimet	2009	2009GeoI37	WTS37055	wbo626	101.359465	30.060652	54.16	5.46	14.4	2395	4360.5	163.7	93.2	12.2	6.3
534	Ouimet	2009	2009GeoI37	WTS37056	wbo633	102.018736	29.597242	3164.97	392.83	6.2	2836	4450.6	587.8	164.8	30.0	6.6
535	Ouimet	2009	2009GeoI37	WTS37057	wbo637	102.250746	28.774070	1712.60	243.16	7.6	1178	2690.9	398.2	160.7	21.3	7.8
536	Ouimet	2009	2009GeoI37	WTS37058	wbo638	101.877010	28.98964	430.76	49.41	24.6	2312	2935.9	661.6	179.0	32.9	7.1
537	Ouimet	2009	2009GeoI37	WTS37059	wbo639	101.895861	28.617989	1263.43	154.88	50.4	3001	2937.8	557.9	227.7	28.2	9.7
538	Ouimet	2009	2009GeoI37	WTS37060	wbo641	101.680052	28.609680	330.66	37.11	33.1	2811	3505.7	580.3	199.5	29.4	8.1
539	Ouimet	2009	2009GeoI37	WTS37061	wbo642	101.537381	28.933927	411.68	46.41	64.0	1917	4054.7	492.2	183.5	25.6	8.4
540	Ouimet	2009	2009GeoI37	WTS37062	wbo643	101.434064	29.509438	237.65	26.32	27.4	1667	4360.8	528.6	180.1	27.3	8.4
541	Ouimet	2009	2009GeoI37	WTS37063	wbo644	101.518783	29.723831	60.78	6.36	18.0	1196	4258.3	433.4	183.2	22.9	8.8
542	Ouimet	2009	2009GeoI37	WTS37064	wbo645	101.388931	29.930083	30.46	3.27	46.9	954	4151.1	269.9	163.3	14.7	8.4
543	Ouimet	2009	2009GeoI37	WTS37065	wbo647	102.005927	29.685772	541.32	64.73	14.4	2395	4298.5	744.0	264.5	35.6	9.9
544	Ouimet	2009	2009GeoI37	WTS37066	wbo651	102.049270	31.293793	123.87	13.77	32.7	2233	3500.2	540.8	172.3	27.9	7.7
545	Ouimet	2009	2009GeoI37	WTS37067	wbo653	101.868561	31.027913	382.72	44.75	63.0	3056	3746.9	604.0	279.7	30.0	9.5
546	Cox	2009	2009JGeoI117	WTS38001	2004-6A	47.125828	-19.003948	14.09	1.61	20.2	1267	1636.5	139.6	81.4	7.9	4.5
547	Cox	2009	2009JGeoI117	WTS38002	2004-9A	47.528971	-18.947121	6.91	0.75	1544.6	546	1457.5	137.0	84.5	7.7	4.7
548	Cox	2009	2009JGeoI117	WTS38003	2004-2A	46.823305	-18.945015	18.89	2.11	134.9	628	1329.0	139.7	80.8	7.9	4.4
549	Cox	2009	2009JGeoI117	WTS38005	2005-3C	48.207700	-17.550344	15.17	1.68	4.5	104	871.1	105.5	54.6	6.0	3.1
550	Cox	2009	2009JGeoI117	WTS38006	2005-6	48.265563	-17.566126	11.22	1.21	2.1	109	812.3	122.4	69.6	6.9	3.9
551	Cox	2009	2009JGeoI117	WTS38007	2005-7	48.203896	-17.628485	24.97	2.72	15.5	134	825.7	98.4	54.9	5.6	3.1
552	Stock	2009	2009LthI1	WTS39001	KC	-111.901207	41.107296	71.81	7.98	3.0	1130	2186.6	394.9	122.0	21.3	6.0
553	Stock	2009	2009LthI1	WTS39002	HCM	-111.902578	41.086336	67.62	7.52	5.4	1364	2297.3	454.9	131.5	24.2	6.3
554	Stock	2009	2009LthI1	WTS39003	HC	-111.897607	41.057279	95.10	10.85	6.5	1249	2312.5	426.9	107.1	22.9	5.3
555	Stock	2009	2009LthI1	WTS39004	SC	-111.887321	41.015408	134.27	14.87	5.8	1261	2186.3	457.0	123.3	24.3	6.0
556	Stock	2009	2009LthI1	WTS39005	SC	-111.871252	40.975788	77.87	8.49	5.8	1238	2231.9	445.2	150.7	23.6	7.2
557	Stock	2009	2009LthI1	WTS39006	FC	-111.869808	40.939735	113.08	12.36	6.1	1358	2244.5	390.4	125.7	21.1	6.2
558	Stock	2009	2009LthI1	WTS39007	CC	-111.862718	40.916973	72.83	8.03	8.1	1234	2130.4	372.3	135.0	20.1	6.8
559	Stock	2009	2009LthI1	WTS39008	HoC	-111.839948	40.881078	102.42	11.38	11.7	1192	2231.4	370.8	125.6	20.1	6.3
560	Stock	2009	2009LthI1	WTS39009	SG	-111.741048	40.620471	195.31	26.02	2.2	1209	2519.6	739.8	200.3	35.8	7.6
561	Stock	2009	2009LthI1	WTS39010	LF	-111.725108	40.575674	522.48	94.44	1.8	1217	2931.4	650.9	139.9	32.7	5.9
562	Stock	2009	2009LthI1	WTS39011	TG	-111.701016	40.579503	568.17	70.86	1.4	830	2981.5	657.1	190.0	32.7	8.3
563	Stock	2009	2009LthI1	WTS39012	CG	-111.736635	40.570449	851.53	108.21	1.9	1414	2734.3	640.2	204.6	31.9	8.5
564	Stock	2009	2009LthI1	WTS39013	NC1	-111.739027	40.541329	620.45	20.45	1.6	1192	2515.8	721.6	128.1	26.5	6.1
565	Stock	2009	2009LthI1	WTS39015	SC	-111.819044	40.521316	110.97	12.64	2.5	996	2430.4	40.7	139.9	23.5	6.7
566	DiBlase	2010	2010EPSL289	WTS40001	SGB1	-118.156667	34.305851	144.34	32.32	174.7	1237	1353.3	322.3	130.0	17.6	6.7
567	DiBlase	2010	2010EPSL289	WTS40002	SGB2	-118.109678	34.306286	157.68	42.92	102.0	1162	1450.9	272.4	132.8	15.0	6.9
568	DiBlase	2010	2010EPSL289	WTS40003	SGB3	-118.123476	34.311617	111.43	20.17	106.4	1128	1426.1	262.6	123.7	14.5	6.5
569	DiBlase	2010	2010EPSL289	WTS40004	SGB4	-118.026632	34.278931	45.40	47.83	6.1	462	1543.9	249.0	112.4	13.8	6.0
570	DiBlase	2010	2010EPSL289	WTS40005	SGB5	-118.120337	34.330368	180.79	40.58	10.3	788	1356.9	297.0	121.1	16.3	6.3
571	DiBlase	2010	2010EPSL289	WTS40006	SGB6	-118.250991	34.328233	332.95	146.58	9.8	826	1289.6	403.2	129.6	21.7	6.4
572	DiBlase	2010	2010EPSL289	WTS40007	SGB7	-118.148114	34.298912	337.48	66.72	3.2	697	1336.1	457.3	148.6	24.2	7.1
573	DiBlase	2010	2010EPSL289	WTS40008	SGB9	-118.255308	34.302540	562.68	63.39	17.3	1162	1146.3	416.2	144.7	22.2	7.1
574	DiBlase	2010	2010EPSL289	WTS40009	SGB10	-118.195807	34.282076	371.17	7.4	918	1197.8	398.8	160.8	21.3	7.9	
575	DiBlase	2010	2010EPSL289	WTS40010	SGB11	-117.740197	34.286596	985.18	111.83	83.0	2089	1904.6	508.2	169.5	26.1	7.9
576	DiBlase	2010	2010EPSL289	WTS40011	SGB12	-117.761320	34.241866	1223.99	145.53	148.9	1771	1275.4	545.0	169.5	28.1	7.7
577	DiBlase															

635	Delunel	2010	2010EPSL293	WTS42006	Rd06	6.443325	44.881765	1499.10	2608.01	27.0	2328	2744.4	712.2	288.6	34.0	11.0
636	Delunel	2010	2010EPSL293	WTS42007	Rd07	6.485743	44.871068	1823.74	3247.37	113.2	2750	2574.4	657.5	314.6	31.7	12.2
637	Delunel	2010	2010EPSL293	WTS42008	Rd08	5.861961	44.941459	376.08	689.24	75.2	1907	1747.2	590.1	248.0	29.5	10.5
638	Delunel	2010	2010EPSL293	WTS42009	Rd09	5.897468	44.890781	308.14	582.08	246.5	2266	1611.3	590.4	248.6	29.4	10.2
639	Delunel	2010	2010EPSL293	WTS42010	Rd10	5.989666	44.880868	426.17	911.22	126.8	2530	1655.2	685.5	256.1	33.3	10.2
640	Delunel	2010	2010EPSL293	WTS42011	Mb130	5.973164	44.793878	686.53	1339.51	791.0	2576	1693.6	420.5	278.9	21.5	12.7
641	Delunel	2010	2010EPSL293	WTS42012	Mb146	6.063577	44.783874	740.14	1379.79	197.0	2702	2043.5	656.1	257.7	32.1	10.3
642	Norton	2010	2010EPL35	WTS43001	Mill	8.324613	46.522058	580.35	88.40	4.1	99	2758.0	168.7	96.1	9.5	5.3
643	Norton	2010	2010EPL35	WTS43002	Ober	8.307186	46.511348	427.38	72.10	3.7	474	2478.3	245.8	135.5	13.6	7.3
644	Norton	2010	2010EPL35	WTS43003	Nider1	8.293027	46.502099	176.65	24.51	3.5	1465	2313.4	491.8	181.5	25.6	8.3
645	Norton	2010	2010EPL35	WTS43006	Ges	8.283070	46.498635	514.71	74.79	4.9	1600	2336.8	535.1	193.4	27.5	8.8
646	Norton	2010	2010EPL35	WTS43007	Mins	8.262189	46.490468	3668.85	1011.17	14.2	1953	2487.1	549.8	245.6	27.7	10.6
647	Norton	2010	2010EPL35	WTS43008	Rec	8.235452	46.465828	1711.96	463.00	9.1	2146	2484.9	577.6	201.1	29.3	8.5
648	Norton	2010	2010EPL35	WTS43009	Hil	8.206290	46.447794	342.33	49.89	1.9	1379	2147.3	511.6	130.1	26.8	5.8
649	Norton	2010	2010EPL35	WTS43011	Wil	8.197988	46.441528	105.59	13.15	4.1	1652	2383.3	429.1	172.3	22.7	8.1
650	Norton	2010	2010EPL35	WTS43012	Wid2	8.170429	46.457049	127.38	24.98	1.4	583	2672.2	336.6	107.8	18.4	5.5
651	Norton	2010	2010EPL35	WTS43013	Ritz	8.228852	46.453712	337.98	61.66	3.9	1390	2196.2	536.6	166.9	27.7	7.7
652	Norton	2010	2010EPL35	WTS43014	Spi	8.216287	46.447851	710.68	138.20	3.2	1417	2179.7	445.1	180.2	23.4	8.5
653	Norton	2010	2010EPL35	WTS43015	Chr	8.203014	46.437143	984.54	236.41	2.6	1261	2037.7	534.1	160.4	27.7	7.3
654	Norton	2010	2010EPL35	WTS43016	Bet	8.189667	46.432071	1709.63	417.19	2.5	1257	2071.9	482.5	188.1	25.1	8.9
655	Norton	2010	2010EPL35	WTS43017	Lou	8.173021	46.419511	998.00	260.38	1.4	1054	1874.0	539.0	157.6	27.9	7.3
656	Abbuheh	2010	2010Geomorph123	WTS44001	Piu11	-79.893302	-4.917906	7.49	0.84	1.3	68	3083.1	83.3	48.8	4.8	2.8
657	Abbuheh	2010	2010Geomorph123	WTS44002	Piu10	-79.995651	-4.944808	152.21	19.52	99.1	2355	2063.5	361.4	210.9	19.1	9.9
658	Abbuheh	2010	2010Geomorph123	WTS44003	Piu9	-80.053940	-5.018422	151.48	20.31	150.8	3035	1717.0	379.6	210.0	20.1	9.5
659	Abbuheh	2010	2010Geomorph123	WTS44004	Piu8	-80.131342	-5.084541	142.12	19.64	184.7	3249	1474.9	351.1	205.3	18.7	9.9
660	Abbuheh	2010	2010Geomorph123	WTS44005	Piu7	-80.158816	-5.103796	103.95	12.04	190.8	3246	1428.2	341.2	210.1	18.2	10.2
661	Abbuheh	2010	2010Geomorph123	WTS44006	2_6	-79.832295	-5.028921	135.35	19.62	12.2	1748	2501.5	488.2	181.6	25.3	10.6
662	Abbuheh	2010	2010Geomorph123	WTS44007	2_8	-79.848928	-5.045665	199.03	40.61	27.2	2015	2194.2	406.9	185.0	21.6	8.5
663	Abbuheh	2010	2010Geomorph123	WTS44008	2_10	-79.874733	-5.059914	293.00	46.75	51.2	2367	2007.1	376.6	174.6	20.1	8.1
664	Abbuheh	2010	2010Geomorph123	WTS44009	2_12	-79.894639	-5.113422	140.06	28.91	136.1	2878	1826.9	373.2	174.9	20.0	8.3
665	Abbuheh	2010	2010Geomorph123	WTS44010	Piu3	-79.910429	-5.138515	175.34	21.91	147.4	3092	1751.9	381.5	178.7	20.4	8.4
666	Abbuheh	2010	2010Geomorph123	WTS44011	Piu4	-80.015318	-5.211379	44.72	6.42	2923.6	3552	1114.2	348.1	195.2	18.6	9.5
667	Abbuheh	2010	2010Geomorph123	WTS44012	Piu7	-80.172137	-5.113840	74.60	12.83	4659.4	3272	456.7	126.5	181.8	6.9	9.4
668	Abbuheh	2010	2010Geomorph123	WTS44013	2_16	-80.343990	-4.936886	18.09	3.28	6390.8	2330	291.1	98.3	157.4	5.4	8.2
669	Abbuheh	2010	2010Geomorph123	WTS44014	Piu2	-80.615476	-5.161892	25.97	3.35	7492.0	521	114.5	25.3	23.3	1.4	1.3
670	Abbuheh	2010	2010Geomorph123	WTS44015	Piu13	-79.950764	-4.929697	171.19	40.30	7.2	1511	2355.7	439.8	199.7	23.1	9.4
671	Abbuheh	2010	2010Geomorph123	WTS44016	Piu12	-79.949696	-4.924669	197.66	24.08	3.5	1227	364.8	126.7	136.7	19.7	6.7
672	Abbuheh	2010	2010Geomorph123	WTS44017	2_4	-80.013174	-4.977419	95.37	14.20	7.7	968	1371.7	432.0	136.3	23.1	6.7
673	Abbuheh	2010	2010Geomorph123	WTS44018	2_3	-80.021490	-4.988294	191.12	33.90	1.3	916	1184.6	552.4	169.7	28.4	7.7
674	Abbuheh	2010	2010Geomorph123	WTS44019	2_2	-80.046446	-5.015069	128.14	19.32	10.1	1380	1021.5	445.4	172.1	23.5	8.1
675	Abbuheh	2010	2010Geomorph123	WTS44020	2_1	-80.073905	-5.041011	69.17	9.14	1.1	504	454.6	309.6	138.5	16.9	7.1
676	Abbuheh	2010	2010Geomorph123	WTS44021	2_5	-79.805621	-5.035561	58.38	7.48	3.4	997	2709.4	384.2	138.6	20.7	6.9
677	Abbuheh	2010	2010Geomorph123	WTS44023	2_9	-79.875566	-5.059915	139.49	17.72	44.0	2132	2131.3	342.5	174.4	18.4	8.6
678	Abbuheh	2010	2010Geomorph123	WTS44024	2_11	-79.876327	-5.101693	38.31	4.96	7.3	1178	1468.7	413.7	165.5	22.0	7.8
679	Abbuheh	2010	2010Geomorph123	WTS44025	2_13	-79.892970	-5.115090	27.19	3.22	3.5	1033	1112.8	567.2	197.2	28.9	8.2
680	Abbuheh	2010	2010Geomorph123	WTS44026	Piu1	-79.889141	-5.998341	6.98	0.89	45.1	28	8.3	11.4	7.3	0.7	0.4
681	Palumbo	2010	2010Geomorph117	WTS45001	06C3-(Y1)	99.610583	39.204618	96.04	12.02	0.2	447	2162.4	226.1	95.5	12.6	5.1
682	Palumbo	2010	2010Geomorph117	WTS45002	07C8-(Y2)	99.616395	39.208921	153.25	19.62	1.2	273	2111.7	188.2	73.5	10.6	4.0
683	Palumbo	2010	2010Geomorph117	WTS45004	06C2-(Y3)	99.621305	39.221758	131.52	16.94	13.2	940	2359.8	306.6	128.1	16.8	6.6
684	Palumbo	2010	2010Geomorph117	WTS45005	06C6-(Y4)	99.743146	39.199361	236.34	31.68	9.3	940	2505.2	321.6	123.1	17.6	6.3
685	Palumbo	2010	2010Geomorph117	WTS45006	06C4-(Y5)	99.756550	39.194789	247.84	33.42	11.1	935	2585.2	292.4	109.3	16.1	5.7
686	Palumbo	2010	2010Geomorph117	WTS45007	06C7-(Y6)	99.863737	39.159650	246.85	34.68	3.8	876	2456.2	399.2	137.2	21.5	6.8
687	Palumbo	2010	2010Geomorph117	WTS45008	06C8-(Y7)	99.889533	39.148988	190.97	24.14	3.4	944	2390.4	409.8	124.1	22.0	6.1
688	Palumbo	2010	2010Geomorph117	WTS45009	06C13-(Y8)	99.879568	39.119904	314.30	41.73	8.9	766	2774.4	384.2	182.6	20.5	8.7
689	Palumbo	2010	2010Geomorph117	WTS45010	06C14-(Y9)	99.925607	39.117305	629.48	148.68	30.6	1204	2594.4	388.6	186.2	20.7	8.9
690	Palumbo	2010	2010Geomorph117	WTS45011	07C1-(Y10)	100.023460	39.047699	366.01	70.69	2.9	796	2061.6	313.4	95.4	17.3	5.0
691	Palumbo	2010	2010Geomorph117	WTS45013	06C1-(Y11)	100.036587	39.027395	164.81	22.76	3.1	280	1874.2	266.7	94.4	15.1	5.2
692	Palumbo	2010	2010Geomorph117	WTS45014	06C15-(Y12)	100.057550	39.018983	374.65	58.00	2.2	826	1910.8	369.1	127.7	16.4	6.3
693	Palumbo	2010	2010Geomorph117	WTS45016	06C25-(L1)	100.365735	39.195221	47.62	5.56	3.8	259	1638.6	112.6	44.3	26.4	3.3
694	Palumbo	2010	2010Geomorph117	WTS45017	07C30-(L2)	100.381861	39.184564	36.99	4.47	7.7	407	1757.9	132.7	59.8	7.5	3.3
695	Palumbo	2010	2010Geomorph117	WTS45020	06C30-(L5)	100.538473	39.097369	608.65	127.96	1.9	323	1698.6	154.1	79.6	8.7	4.4
696	Palumbo	2010	2010Geomorph117	WTS45021	06C18-(L6)	100.634367	39.053448	232.44	37.76	6.1	848	2106.5	330.8	192.6	17.7	9.2
697	Palumbo	2010	2010Geomorph117	WTS45022	06C19-(L7)	100.648572	39.045771	228.67	33.28	1.0	661	2189.7	516.8	211.4	26.6	9.8
698	Palumbo	2010	2010Geomorph117	WTS45024	06C17-(L8)	100.709206	39.055365	155.25	19.13	26.0	1517	2747.5	275.5	180.4	15.0	9.2
699	Palumbo	2010	2010Geomorph117	WTS45025	06C23-(L9)	100.805481	38.957468	245.99	30.62	15.9	1350	2962.5	399.8	135.5	21.5	6.7
700	Palumbo	2010	2010Geomorph117	WTS45026	06C21-(L10)	100.841564	38.945689	151.94	18.63	7.9	989	2859.7	362.1	129.1	19.6	6.4
701	Insel	2010	2010Geomorph122	WTS46001	N02	-67.039807	-15.161430	988.35	152.45	48.2	934	630.3	266.7	156.9	14.6	7.9
702	Insel	2010	2010Geomorph122	WTS46002	N04	-67.115246	-15.384047	126.05	16.47	333.4	1115.1	254.9	143.4	14.0	7.3	
703	Insel	2010	2010Geomorph122	WTS46004	N05	-67.168872	-15.505135	124.65	15.73	206.3	1209	1041.6	246.6	138.3	16.6	6.3
704	Insel	2010	2010Geomorph122	WTS46005</												

763	Norton	2011	2011IntEarthSci00	WTS50023	Oglio	10.349160	46.159059	882.25	135.57	462.9	2876	1940.0	502.6	215.5	25.9	9.6
764	Norton	2011	2011IntEarthSci00	WTS50024	Pfltsch	11.473587	46.902141	714.43	125.07	133.3	2477	2096.2	532.3	239.8	27.0	10.5
765	Norton	2011	2011IntEarthSci00	WTS50025	Pitze	10.740581	47.148834	990.27	170.25	250.7	2765	2380.7	548.7	248.9	27.7	10.7
766	Norton	2011	2011IntEarthSci00	WTS50026	Plima	10.825640	46.598113	1745.45	468.49	158.9	2913	2438.9	498.8	213.2	25.5	9.5
767	Norton	2011	2011IntEarthSci00	WTS50027	Schalz	10.978010	46.648950	850.30	135.84	220.8	3007	2372.0	554.4	217.2	28.2	9.5
768	Norton	2011	2011IntEarthSci00	WTS50028	Silla	11.159620	46.086612	255.49	48.17	27.9	1508	987.6	280.6	168.8	15.3	8.6
769	Norton	2011	2011IntEarthSci00	WTS50029	Taller	11.354447	46.514723	383.29	60.16	416.2	2392	1692.7	415.6	184.9	22.0	8.8
770	Norton	2011	2011IntEarthSci00	WTS50030	Tauern	12.527477	47.086253	1686.35	299.85	84.7	2218	2377.0	500.7	228.4	25.7	9.9
771	Norton	2011	2011IntEarthSci00	WTS50031	Watten	11.596998	47.278617	638.38	99.26	69.8	2099	1933.8	451.0	157.1	23.9	7.4
772	Norton	2011	2011IntEarthSci00	WTS50032	Widschoenau	11.990226	47.460168	784.31	178.69	85.7	1678	1313.2	391.9	155.2	21.0	7.6
773	Norton	2011	2011IntEarthSci00	WTS50033	Zemm	11.831783	47.151232	1085.70	181.23	231.9	2788	2249.1	592.2	249.0	29.6	10.2
774	Norton	2011	2011IntEarthSci00	WTS50034	Ziel	11.061324	46.670583	1057.90	179.84	31.7	2752	2349.3	557.0	218.8	28.3	9.5
775	Norton	2011	2011IntEarthSci00	WTS50035	di Adame	10.351340	46.078298	735.84	109.43	116.0	3005	2049.1	539.9	228.2	27.5	10.0
776	Norton	2011	2011IntEarthSci00	WTS50036	val Moena	11.452084	46.274329	207.53	26.72	23.5	1581	1844.3	503.2	214.9	25.9	9.5
777	Norton	2011	2011IntEarthSci00	WTS50037	di Venina	9.912470	46.162458	1100.65	295.32	66.2	2635	1866.8	602.5	228.2	30.9	9.5
778	Palumbo	2011	2011TerraNova23	WTS51001	07C44-(Q1)	97.227000	39.716000	98.09	11.60	347.3	1772	3492.8	270.6	146.0	14.9	7.5
779	Palumbo	2011	2011TerraNova23	WTS51002	07C41-(Q2)	97.512000	39.680000	49.93	5.57	537.5	2306	3871.8	324.6	197.5	17.4	10.0
780	Palumbo	2011	2011TerraNova23	WTS51003	07C42-(Q3)	97.660000	39.643000	130.69	15.64	665.0	2272	3678.0	330.8	187.0	17.8	9.4
781	Palumbo	2011	2011TerraNova23	WTS51004	07C43-(Q4)	97.695000	39.403000	209.37	25.13	5.5	1074	4317.2	508.4	159.3	26.5	7.4
782	Palumbo	2011	2011TerraNova23	WTS51005	07C45-(Q5)	97.629000	39.400000	62.51	7.02	67.0	1427	4226.8	424.6	161.1	22.6	7.8
783	Palumbo	2011	2011TerraNova23	WTS51006	07C46-(Q6)	98.815000	39.339000	1119.14	149.98	565.8	3230	3787.2	508.7	200.3	26.3	9.2
784	Palumbo	2011	2011TerraNova23	WTS51007	07C19-(Q7)	99.053000	39.250000	498.51	62.38	41.5	2000	3285.9	556.9	164.7	28.6	7.6
785	Palumbo	2011	2011TerraNova23	WTS51008	07C13-(Q8)	99.169000	39.162000	563.56	69.68	557.2	2896	3765.8	511.1	186.4	26.5	8.6
786	Palumbo	2011	2011TerraNova23	WTS51009	07C12-(Q9)	99.246000	39.075000	660.57	88.62	56.1	1884	3594.3	533.3	166.4	27.6	7.6
787	Palumbo	2011	2011TerraNova23	WTS51010	07C20-(Q10)	99.287000	39.027000	1482.13	265.64	38.2	2047	3823.2	561.1	165.4	28.8	7.5
788	Palumbo	2011	2011TerraNova23	WTS51011	07C23-(Q11)	99.529000	38.856000	134.62	16.35	57.3	2107	3631.8	528.4	127.7	27.3	7.9
789	Palumbo	2011	2011TerraNova23	WTS51012	06C16-(Q12)	99.555000	38.495000	235.33	28.82	813.2	1528	3785.9	473.2	183.9	26.8	6.9
790	Palumbo	2011	2011TerraNova23	WTS51013	06C32-(Q13)	100.036000	38.671000	422.97	49.60	9430.6	2953	3730.1	302.8	218.2	16.2	10.8
791	Palumbo	2011	2011TerraNova23	WTS51015	06C34-(L12)	100.954000	39.036000	19.79	2.21	5.3	950	2687.1	199.3	67.3	11.2	3.7
792	Palumbo	2011	2011TerraNova23	WTS51017	06C12-(H3)	100.073342	39.649268	113.80	20.50	2.4	239	1905.6	141.0	62.5	8.0	3.5
793	Codilean	2012	QuatGeoChr	WTS52001	N2A	16.089481	-23.478488	16.59	1.92	95.2	1405	1356.7	191.9	160.6	10.6	8.4
794	Codilean	2012	QuatGeoChr	WTS52002	N2B	16.090390	-23.480911	16.95	1.92	81.3	1040	1335.4	195.8	163.1	10.8	8.5
795	Codilean	2012	QuatGeoChr	WTS52003	N2D	16.245457	-23.482986	16.70	1.99	19.7	871	1358.9	216.1	160.9	11.9	8.5
796	Codilean	2012	QuatGeoChr	WTS52004	N2F	16.278043	-23.477074	15.76	1.78	73.8	1098	1631.6	230.2	159.6	12.6	8.3
797	Codilean	2012	QuatGeoChr	WTS52005	N3A	16.459222	-23.365757	3.85	0.44	10.0	85	1764.4	27.6	13.0	1.6	0.7
798	Codilean	2012	QuatGeoChr	WTS52006	N3B	16.434851	-23.387140	6.00	0.70	18.4	210	1751.4	31.5	23.6	1.8	1.3
799	Codilean	2012	QuatGeoChr	WTS52007	N3C	16.433583	-23.370752	6.51	0.74	81.1	205	1816.7	30.7	20.3	2.3	1.2
800	Scharf	2012	Geology(in review)	WTS53001	S3.1	20.664803	-33.995580	6.13	0.68	8.4	1345	847.8	467.3	304.8	23.5	13.4
801	Scharf	2012	Geology(in review)	WTS53002	S4.1	20.705780	-33.993210	4.72	0.54	328.5	1346	635.7	220.9	168.6	12.1	8.5
802	Scharf	2012	Geology(in review)	WTS53003	S6.1	21.407692	-33.434303	3.86	0.44	63.6	1671	1252.0	393.1	265.6	20.3	12.2
803	Scharf	2012	Geology(in review)	WTS53004	S07	21.351937	-34.021483	2.32	0.29	6.0	1070	462.6	266.8	157.0	14.6	7.7
804	Scharf	2012	Geology(in review)	WTS53005	S08	20.846127	-33.983784	3.35	0.39	25.7	1253	737.2	369.3	171.3	19.8	8.4
805	Scharf	2012	Geology(in review)	WTS53006	S09	20.376457	-33.981517	6.49	0.72	16.5	1258	905.9	439.7	222.9	22.9	10.2
806	Scharf	2012	Geology(in review)	WTS53007	S10	20.423264	-33.984923	7.95	0.90	8.8	1431	1013.7	645.5	322.9	31.2	11.6
807	Scharf	2012	Geology(in review)	WTS53008	S11	21.214118	-33.463145	7.44	0.85	16.9	1540	1337.1	558.9	251.6	28.0	10.7
808	Scharf	2012	Geology(in review)	WTS53009	S12	22.356838	-33.398385	3.30	0.39	8.7	1180	1435.3	436.1	169.0	23.1	7.5
809	Scharf	2012	Geology(in review)	WTS53010	S13	22.180246	-33.365099	5.77	0.67	13.5	1185	1367.2	462.9	183.5	24.3	8.5
810	Bierman	2001	2001BookChapter	WTS55001	dC-01	-123.967373	44.405655	147.53	28.82	157.2	3554	356.4	298.4	133.2	16.4	6.9
811	Bierman	2001	2001BookChapter	WTS55003	dC-03a	-123.922432	44.496178	153.85	61.96	2.5	305	329.1	278.4	114.2	15.4	6.1
812	Bierman	2001	2001BookChapter	WTS55006	dC-22	-124.008634	44.427800	156.82	60.14	177.5	873	332.3	291.4	132.9	16.0	6.9
813	Bierman	2001	2001BookChapter	WTS55007	dC-29	-123.852264	44.536990	113.11	43.79	3.5	241	280.6	185.8	83.7	10.5	4.6
814	Bierman	2001	2001BookChapter	WTS55008	dC-30	-123.867247	44.523661	180.98	98.29	16.4	354	285.0	247.4	111.6	13.7	6.0
815	Bierman	2001	2001BookChapter	WTS55009	dC-31	-123.859200	44.508666	65.82	11.18	19.0	354	284.0	246.6	108.9	13.7	5.8
816	Bierman	2001	2001BookChapter	WTS55010	dC-35	-123.818105	44.518983	137.75	25.01	7.2	363	340.9	229.8	105.1	12.8	5.6
817	Bierman	2001	2001BookChapter	WTS55011	dC-36	-123.817809	44.515570	153.56	40.00	4.4	394	384.1	284.0	135.5	15.6	7.1
818	Bierman	2001	2001BookChapter	WTS55012	dC-37	-123.821370	44.513888	146.44	56.38	11.8	394	353.1	250.0	120.4	13.9	6.4
819	Bierman	2001	2001BookChapter	WTS55013	dC-38	-123.853923	44.507523	138.31	34.40	54.4	733	404.1	287.3	126.1	15.8	6.6
820	Bierman	2001	2001BookChapter	WTS55014	dC-40	-123.859200	44.506775	300.11	106.66	75.6	740	373.1	276.6	123.3	15.2	6.3
821	Clapp	2001	2001QuatRes55	WTS56003	ECAC-10	-107.102046	35.698518	74.51	8.49	2.3	86	1979.5	56.5	32.7	3.2	1.9
822	Clapp	2001	2001QuatRes55	WTS56004	ECAC-11.1	-107.106698	35.703721	122.89	20.13	8.2	129	1950.4	47.9	30.6	2.7	1.7
823	Perg	2003	2003Geo31	WTS57001	SGC	-122.386714	37.325958	225.83	28.89	131.5	758	324.3	202.5	93.7	11.4	5.1
824	Perg	2003	2003Geo31	WTS57002	PC	-122.405629	37.264445	233.97	29.21	154.0	818	312.3	228.4	108.8	12.7	5.9
825	Perg	2003	2003Geo31	WTS57003	WC	-122.270017	37.112763	282.46	33.49	59.1	699	366.4	243.3	122.5	13.5	6.4
826	Perg	2003	2003Geo31	WTS57004	SC	-122.229980	37.066233	94.68	13.08	64.7	788	429.9	226.9	126.1	12.6	6.7
827	Perg	2003	2003Geo31	WTS57005	SLR	-122.023873	36.972233	204.13	24.70	303.7	980	360.0	222.0	112.0	12.4	6.0
828	Bierman	2007	2007QuatInt167/168	WTS58007	NlC4	16.276566	-23.972339	5.36	0.59	1.5	230	1585.7	173.6	82.8	9.8	4.6
829	Bierman	2007	2007QuatInt167/168	WTS58014	O1280	15.074826	-21.454825	10.12	1.08	7966.5	1570	1280.3	49.2	87.1	2.8	4.7
830	Bierman	2007	2007QuatInt167/168	WTS58015	O1289	15.226896	-21.289307	8.69	0.98	173.9	286	1008.0	23.4	20.3	1.3	1.2
831	Bierman	2007	2007QuatInt167/168	WTS58016	O1495	15.201610	-21.442461	13.02	1.12	7369.9	1465	1305.5	13.2	89.9	2.8	4.5
832	Bierman	2007	2007QuatInt167/168	WTS58017	O1710	15.406151	-21.348415	10.55	1.16	6567.2	1353	1340.2	52.9	94.1	3.0	5.1
833	Bierman	2007	2007													

891	Duxbury	2008	2008MScThesis	WTS62024	SH-12	-78.256347	38.614236	14.47	1.54	14.2	804	696.8	228.0	113.4	12.7	6.1
892	Duxbury	2008	2008MScThesis	WTS62026	SH-14	-78.279023	38.525865	15.70	1.79	11.9	777	456.9	242.3	115.9	13.5	6.2
893	Duxbury	2008	2008MScThesis	WTS62027	SH-15	-78.290465	38.521291	11.88	1.29	6.0	618	426.9	250.0	115.3	14.0	6.2
894	Duxbury	2008	2008MScThesis	WTS62028	SH-16	-78.351143	38.542752	21.74	2.34	13.8	848	870.3	223.3	113.8	12.4	6.1
895	Duxbury	2008	2008MScThesis	WTS62029	SH-17	-78.365801	38.779505	4.41	0.50	9.3	667	479.4	220.1	88.8	12.3	4.8
896	Duxbury	2008	2008MScThesis	WTS62030	SH-18	-78.355555	38.648669	4.61	0.53	3.2	460	592.7	185.9	62.0	10.5	3.4
897	Duxbury	2008	2008MScThesis	WTS62031	SH-19	-78.496620	38.470814	12.49	1.30	11.5	681	822.5	253.9	108.8	14.1	5.8
898	Duxbury	2008	2008MScThesis	WTS62032	SH-20	-78.662214	38.357270	6.16	0.68	1.6	490	570.0	253.5	104.6	14.1	5.6
899	Duxbury	2008	2008MScThesis	WTS62033	SH-21	-78.368855	38.645894	13.48	1.45	5.7	630	698.1	302.5	134.2	16.6	7.0
900	Duxbury	2008	2008MScThesis	WTS62034	SH-22	-78.421681	38.613359	7.70	0.85	2.9	688	498.2	231.1	142.8	12.8	7.6
901	Duxbury	2008	2008MScThesis	WTS62035	SH-23	-78.177837	38.868771	16.38	1.75	18.8	498	496.4	197.3	86.3	11.1	4.7
902	Duxbury	2008	2008MScThesis	WTS62036	SH-24	-78.745015	38.165650	11.78	1.31	3.7	444	729.1	286.2	109.5	15.8	5.8
903	Duxbury	2008	2008MScThesis	WTS62037	SH-25	-78.748704	38.147983	8.00	0.95	25.3	649	705.1	269.6	113.2	14.9	6.0
904	Duxbury	2008	2008MScThesis	WTS62038	SH-26	-78.620780	38.293101	10.19	1.10	2.5	368	793.3	222.3	63.0	12.5	3.5
905	Duxbury	2008	2008MScThesis	WTS62039	SH-27	-78.803653	38.099436	5.19	0.56	5.7	404	626.2	253.1	102.5	14.2	5.5
906	Duxbury	2008	2008MScThesis	WTS62040	SH-28	-78.804286	38.088903	5.64	0.61	5.7	404	626.2	252.4	102.3	14.2	5.5
907	Duxbury	2008	2008MScThesis	WTS62043	SH-31	-78.802352	38.160826	7.12	0.77	8.5	423	723.5	269.5	103.0	14.9	5.4
908	Duxbury	2008	2008MScThesis	WTS62044	SH-32	-78.726397	38.310125	4.18	0.47	1.1	316	475.2	172.9	96.9	9.7	5.3
909	Duxbury	2008	2008MScThesis	WTS62045	SH-33	-78.726145	38.311243	4.29	0.47	1.1	323	471.2	168.3	97.3	9.5	5.3
910	Duxbury	2008	2008MScThesis	WTS62049	SH-37	-78.745005	38.252435	7.75	0.83	1.5	384	608.7	296.4	97.9	16.4	5.2
911	Duxbury	2008	2008MScThesis	WTS62050	SH-38	-78.769050	38.256404	8.37	0.92	15.2	587	644.9	293.1	121.3	16.1	6.3
912	Duxbury	2008	2008MScThesis	WTS62051	SH-39	-78.781203	38.221484	8.74	1.05	3.0	477	750.4	377.5	124.1	20.4	6.3
913	Duxbury	2008	2008MScThesis	WTS62052	SH-40	-78.691978	38.237605	7.56	0.83	3.3	451	804.0	248.0	84.4	13.8	4.5
914	Duxbury	2008	2008MScThesis	WTS62055	SH-43	-78.573897	38.362567	13.84	1.48	2.1	368	635.2	201.7	66.1	11.4	3.6
915	Duxbury	2008	2008MScThesis	WTS62056	SH-44	-78.456666	38.340308	8.44	0.95	1.3	89	267.2	60.3	40.5	3.4	2.3
916	Duxbury	2008	2008MScThesis	WTS62057	SH-45	-78.264454	38.523572	8.77	0.98	4.1	228	259.0	157.1	97.6	8.8	5.4
917	Duxbury	2008	2008MScThesis	WTS62058	SH-46	-78.245238	38.640869	19.23	2.24	5.6	355	445.5	251.8	89.0	14.0	7.6
918	Duxbury	2008	2008MScThesis	WTS62059	SH-47	-78.208541	38.647031	11.64	1.28	12.5	437	305.0	151.4	96.9	8.5	5.4
919	Duxbury	2008	2008MScThesis	WTS62060	SH-48	-78.105874	38.837972	13.08	1.43	16.9	531	395.9	165.8	86.2	9.3	4.8
920	Duxbury	2008	2008MScThesis	WTS62061	SH-49	-78.176853	38.926428	3.01	0.34	10.9	292	278.5	111.4	57.2	6.3	3.2
921	Duxbury	2008	2008MScThesis	WTS62063	SH-51	-78.239188	38.796486	10.45	1.14	4.6	648	555.0	233.2	98.1	13.0	5.3
922	Duxbury	2008	2008MScThesis	WTS62064	SH-52	-78.234472	38.809462	11.52	1.24	22.9	761	578.2	230.5	129.9	12.8	6.9
923	Duxbury	2008	2008MScThesis	WTS62065	SH-54	-78.723673	38.289722	14.47	1.59	1.8	314	680.8	343.2	113.7	18.8	5.9
924	Duxbury	2008	2008MScThesis	WTS62066	SH-56	-78.600542	38.531411	6.17	0.66	3310.4	1090	529.2	118.6	115.3	6.7	6.3
925	Bierman	2009	2009GSAPortland	WTS63001	QLD1	145.636743	-16.821640	19.73	2.11	8.0	300	408.9	113.7	92.9	6.4	5.1
926	Bierman	2009	2009GSAPortland	WTS63002	QLD2	145.637389	-16.821640	21.17	2.30	8.0	302	408.5	113.3	92.7	6.4	5.1
927	Bierman	2009	2009GSAPortland	WTS63003	QLD3	145.637416	-16.831143	22.20	4.51	55.6	1197	588.7	242.6	144.9	14.0	7.6
928	Bierman	2009	2009GSAPortland	WTS63004	QLD4	145.689070	-16.947526	49.34	5.21	1.2	599	302.4	371.4	165.7	19.9	8.3
929	Bierman	2009	2009GSAPortland	WTS63005	QLD5	145.684669	-16.851790	17.41	2.01	1991.5	1239	593.1	93.0	95.7	5.2	5.3
930	Bierman	2009	2009GSAPortland	WTS63006	QLD6	145.670725	-16.873312	6.55	0.72	10.8	966	461.9	298.6	166.7	16.2	8.3
931	Bierman	2009	2009GSAPortland	WTS63007	QLD7	145.561044	-16.906751	21.60	2.35	76.6	624	521.9	137.0	110.9	7.7	6.1
932	Bierman	2009	2009GSAPortland	WTS63008	QLD8	145.550810	-16.899389	20.78	2.21	142.6	871	593.9	147.8	118.0	8.3	6.4
933	Bierman	2009	2009GSAPortland	WTS63009	QLD9a	145.512138	-16.823791	15.35	1.66	287.6	894	536.5	132.3	111.1	7.4	6.1
934	Bierman	2009	2009GSAPortland	WTS63012	QLD10	145.617465	-16.800974	15.53	1.73	1941.5	955	598.2	92.3	94.9	5.2	5.2
935	Bierman	2009	2009GSAPortland	WTS63013	QLD11	145.644454	-16.792279	19.08	2.07	4.1	111	406.3	84.3	49.3	4.8	2.8
936	Bierman	2009	2009GSAPortland	WTS63014	QLD12	145.654399	-16.826769	29.38	3.13	1.7	246	449.3	195.9	111.1	11.0	6.1
937	Bierman	2009	2009GSAPortland	WTS63015	QLD13	145.682219	-16.833059	62.05	6.81	2.5	563	318.5	331.7	130.9	18.1	6.8
938	Bierman	2009	2009GSAPortland	WTS63016	QLD14	145.681678	-16.815805	56.78	6.12	1.4	569	313.7	421.1	139.6	22.5	6.8
939	Heimsath	2009	2009ESPL34	WTS64001	TC-17	133.297338	-12.469143	22.58	2.87	1.6	100	133.9	103.2	84.8	5.8	4.8
940	Heimsath	2009	2009ESPL34	WTS64003	TC-20	133.289146	-12.458477	50.82	6.94	11.9	159	123.3	70.3	56.0	4.0	3.2
941	Heimsath	2009	2009ESPL34	WTS64004	TC-21	133.288191	-12.455040	39.68	4.90	12.5	165	120.7	68.9	55.3	3.9	3.1
942	Heimsath	2009	2009ESPL34	WTS64005	TC-22S	133.269901	-12.453331	10.45	1.96	387.3	331	215.5	66.1	71.3	3.8	4.0
943	Godard	2010	2010Tectonophysics491	WTS65001	LM253	103.485067	31.057257	690.21	149.71	1735.9	5016	3536.8	624.0	233.0	31.0	9.5
944	Godard	2010	2010Tectonophysics491	WTS65003	LM259	103.579893	31.487991	776.92	251.42	4626.1	4259	3617.2	608.2	218.6	30.5	9.1
945	Godard	2010	2010Tectonophysics491	WTS65006	SC004	103.469989	30.760824	193.55	53.79	341.8	3134	1899.8	517.3	226.0	26.5	9.7
946	Godard	2010	2010Tectonophysics491	WTS65007	SC016	103.792395	31.236703	227.32	107.91	337.8	3545	2490.6	681.9	288.7	32.9	11.3
947	Godard	2010	2010Tectonophysics491	WTS65008	SC031	104.000725	31.459914	807.33	226.43	315.8	3895	2948.9	699.4	279.2	33.6	10.7
948	Godard	2010	2010Tectonophysics491	WTS65009	SC033	103.951846	31.131712	229.76	66.91	58.7	1438	400.3	459.2	153.5	21.4	7.4
949	Godard	2010	2010Tectonophysics491	WTS65011	SC059	103.492366	31.065810	343.66	88.08	5.2	1169	1503.9	564.5	154.8	29.0	6.9
950	Godard	2010	2010Tectonophysics491	WTS65012	SC071	104.113199	31.515926	277.77	70.96	318.5	3532	2272.8	600.1	233.4	30.0	9.8
951	Guralnik	2010	2010EPLS1290	WTS66001	N4-N-SC	34.938130	30.487430	14.22	1.77	16.3	291	555.2	140.1	108.4	7.9	5.9
952	Guralnik	2010	2010EPLS1290	WTS66002	N4-R-SD	34.938240	30.599978	28.81	3.36	214.4	612	595.6	97.4	118.2	5.4	6.3
953	Guralnik	2010	2010EPLS1290	WTS66003	N4-NR-SD	34.942795	30.591668	30.77	4.25	343.5	627	605.5	95.1	104.7	5.3	5.7
954	Guralnik	2010	2010EPLS1290	WTS66004	N1-SD	35.105961	30.661849	41.16	5.02	797.7	940	512.9	106.2	110.2	6.0	5.9
955	Heimsath	2010	2010GSSP346	WTS67003	MD-110S	132.535501	-23.590633	0.74	0.12	212.6	668	821.4	82.7	87.4	4.7	4.8
956	Heimsath	2010	2010GSSP346	WTS67005	MD-119S	132.354850	-23.699221	8.57	1.68	10.0	123	790.3	45.2	26.5	2.6	1.5
957	Placzek	2010	2010EPLS1295	WTS68001	ADSO-6SD	-68.593472	-24.119957	1.27	0.16	137.7	1548	3611.2	138.4	92.1	7.8	5.1
958	Placzek	2010	2010EPLS1295	WTS68002	ADBA-2SD	-69.030839	-23.535933	1.35	0.17	4194.5	2033	2774.3	75.8	71.8	4.3	4.0
959	Placzek	2010	2010EPLS1295	WTS68003	ASOI-SD	-70.280699	-24.058559	0.92	0.12	532.6	1755	1800.1	136.1	89.5	7.7	4.9
960	Placzek	2010	2010EPLS1295	WTS68004	ADBA-5SD	-69.474163	-23.394990	1.01	0.13	763.5	1275	2038.7	62.0	52.9	3.5	2.9
961	Placzek	2010	2010EPLS1295	WTS68005	ADSA-1SD	-68.109296	-23.785608	2.37	0.32	242.9	2260	3367.9	100.4</			

REFERENCES:

- 1 Abbuehl LM, Norton KP, Schlunegger F, Kracht O, Aldahan A, Possnert G, 2010, El Nino forcing on 10Be-based surface denudation rates in the northwestern Peruvian Andes. *Geomorphology* 123(3-4):257-268.
- 2 Belmont P, Pazzaglia FJ, Gosse JC, 2007, Cosmogenic 10-Be as a Tracer for Hillslope and Channel Sediment Dynamics in the Clearwater River Basin, Western Washington State. *Earth and Planetary Science Letters*. 264:123-135.
- 3 Bierman, PR, Albrecht A, Bothner M, Brown E, Bullen T, Gray L, Turpin, L, 1998, Weathering, erosion and sedimentation, in Kendall, C, and McDonnell, JJ, eds., *Isotope Tracers in Catchment Hydrology*, Elsevier, p. 647-678.
- 4 Bierman P, Caffee M, 2001, Steady state rates of rock surface erosion and sediment production across the hyperarid Namib desert and the Namibian escarpment, southern Africa. *American Journal of Science* 301:326-358.
- 5 Bierman PR, Reuter JM, Pavich M, Gellis A, Caffee MW, Larsen J, 2005, Using cosmogenic nuclides to contrast rates and scales of sediment production and sediment yield in the semi-arid, arroyo-dominated landscape of the Rio Puerco Basin, New Mexico. *Earth Surface Processes and Landforms* 30:935-953.
- 6 Bierman, PR, Clapp, EM, Nichols, KK, Gillespie, AR, Caffee, M, 2001, Using cosmogenic nuclide measurements in sediments to understand background rates of erosion and sediment transport, in Harmon, RS, and Doe, WM, eds., *Landscape Erosion and Evolution Modelling*: New York, Kluwer, p. 89-116.
- 7 ***Bierman, PR, Nichols, KK, Matmon, A, Enzel, Y, Larsen, J, Finkel, R, 2007, 10-Be shows that Namibian drainage basins are slowly, steadily and uniformly eroding. *Quaternary International* 167–168(3):33.**
- 8 ***Bierman, PR, Reusser, LJ, Nichols, KK, Matmon, A, Rood, D, 2009, Where is the sediment coming from and where is it going - A 10Be examination of the northern Queensland escarpment, Australia, 2009 Portland GSA Annual Meeting: Portland, Or.**
- 9 Binnie SA, Phillips WM, Summerfield MA, Fifield LK, 2006, Sediment mixing and basin-wide cosmogenic nuclide analysis in rapidly eroding mountainous environments. *Quaternary Geochronology* 1:4-14.
- 10 Binnie SA, Phillips WM, Summerfield MA, Fifield LK, 2007, Tectonic uplift, threshold hillslopes, and denudation rates in a developing mountain range. *Geology*, 35:743-746.
- 11 Binnie SA, Phillips WM, Summerfield MA, Fifield LK, Spotila JA, 2008, Patterns of denudation through time in the San Bernardino Mountains, California: Implications for early-stage orogenesis. *Earth and Planetary Science Letters* 276:62-72.
- 12 Brown ET, Stallard RF, Larsen MC, Bourlès DL, Raisbeck GM, Yiou F, 1998, Determination of predevelopment denudation rates of an agricultural watershed (Cayaguás River, Puerto Rico) using in-situ-produced 10Be in riverborne quartz. *Earth and Planetary Science Letters* 160:723-728.
- 13 Chappell J, Zheng H, Fifield K, 2006, Yangtze River sediments and erosion rates from source to sink traced with cosmogenic 10Be: Sediments from major rivers. *Palaeogeography, Palaeoclimatology, Palaeoecology* 241(1):79-94.
- 14 Clapp E, Bierman PR, Caffee M, 2002, Using 10Be and 26Al to determine sediment generation rates and identify sediment source areas in an arid region drainage basin. *Geomorphology* 45:67-87.
- 15 Clapp, EM, Bierman, PR, Nichols, KK, Pavich, M, Caffee, M, 2001, Rates of sediment supply to arroyos from upland erosion determined using in situ produced cosmogenic 10Be and 26Al. *Quaternary Research* (New York), 55(2):235-245.
- 16 Codilean AT, Bishop P, Stuart FM, Hoey TB, Fabel D, Freeman, SPHT, 2008, Single-grain cosmogenic Ne-21 concentrations in fluvial sediment reveal spatially variable erosion rates. *Geology* 36(2):159-162.
- 17 Codilean, AT, Fenton, CR, Fabel, D, Bishop, P, Xu, S, 2012, Discordance between cosmogenic nuclide concentrations in amalgamated sands and individual fluvial pebbles in an arid zone catchment. *Quaternary Geochronology*, doi.
- 18 Cox R, Bierman PR, Jungers MC, Rakotondrazafy AFM, 2009, Erosion Rates and Sediment Sources in Madagascar Inferred from 10Be Analysis of Lavaka, Slope, and River Sediment. *Journal of Geology* 117:363.
- 19 Cyr AJ, Granger DE, Olivetti V, Molin P, 2010, Quantifying rock uplift rates using channel steepness and cosmogenic nuclide-determined erosion rates: Examples from northern and southern Italy: *Lithosphere* 2:188-198.
- 20 Delunel R, van der Beek PA, Carcaillet J, Bourlès DL, Valla PG., 2010, Frost-cracking control on catchment denudation rates: Insights from in situ produced 10Be concentrations in stream sediments (Ecrins-Pelvoux massif, French Western Alps). *Earth and Planetary Science Letters* 293(1-2):72-83.
- 21 Densmore AL, Hetzel R, Ivy-Ochs S, Krugh WC, Dawers N, Kubik P, 2009, Spatial variations in catchment-averaged denudation rates from normal fault footwalls. *Geology* 37:1139-1142.
- 22 DiBiase R, Whipple K, Heimsath A, Ouimet W, 2010, Landscape form and millennial erosion rates in the San Gabriel Mountains, CA. *Earth and Planetary Science Letters* 289:134-144.
- 23 ***Duxbury, J, 2009, Erosion rates in and around Shenandoah National Park, VA, determined using analysis of cosmogenic 10Be. University of Vermont M.Sc. Thesis, pp. 134.**
- 24 Ferrier KL, Kirchner JW, Finkel RC, 2005, Erosion rates over millennial and decadal timescales at Caspar Creek and Redwood Creek, Northern California Coast Ranges. *Earth Surface Processes and Landforms* 30:1025–1038.
- 25 Finnegan NJ, Hallet B, Montgomery DR, Zeitler PK, Stone JO, Anders, AM, Liu Y, 2008, Coupling of rock uplift and river incision in the Namche Barwa-Gyala Peri massif, Tibet. *Geological Society of America Bulletin* 120:142-155.
- 26 Godard, V, Lavé, J, Carcaillet, J, Cattin, R, Bourlès, D, Zhu, J, 2010, Spatial distribution of denudation in Eastern Tibet and regressive erosion of plateau margins. *Tectonophysics*, 491:253-274.
- 27 Guralnik, B, Matmon, A, Avni, Y, and Fink, D, 2010, 10Be exposure ages of ancient desert pavements reveal Quaternary evolution of the Dead Sea drainage basin and rift margin tilting. *Earth and Planetary Science Letters*, 290:132-141.
- 28 Harkins, N, Kirby, E, Heimsath, A, Robinson, R, Reiser, U, 2007, Transient fluvial incision in the headwaters of the Yellow River, northeastern Tibet, China. *Journal of Geophysical Research*, 112:F03S04.
- 29 Heimsath, AM, Fink, D, Hancock, GR, 2009, The 'humped' soil production function: eroding Arnhem Land, Australia. *Earth Surface Processes and Landforms*, 34:1674-1684.
- 30 Heimsath, AM, Chappell, J, Fifield, K, 2010, *Eroding Australia: rates and processes from Bega Valley to Arnhem Land*. Geological Society, London, Special Publications, 346:225-241.
- 31 Henck, AC, Huntington, KW, Stone, JO, Montgomery, DR, and Hallet, B, 2011, Spatial controls on erosion in the Three Rivers Region, southeastern Tibet and southwestern China. *Earth and Planetary Science Letters*, 303:71-83.
- 32 Insel N., Ehlers T.A., Schaller M., Barnes J.B., Tawackoli S., Poulsen C.J., 2010, Spatial and temporal variability in denudation across the Bolivian Andes from multiple geochronometers. *Geomorphology* 122(1-2): 65-77.
- 33 Kirchner J.W., Finkel R.C., Riebe C.S., Granger D.E., Clayton J.L., King J.G., Megahan W.F., 2001, Mountain erosion over 10 yr, 10 k.y., and 10 m.y. time scales. *Geology* 29:591-594.
- 34 Kober F., Ivy-Ochs S., Zeilinger G., Schlunegger F., Kubik P.W., Baur H., Wieler R., 2009, Complex multiple cosmogenic nuclide concentration and histories in the arid Rio Lluta catchment, northern Chile. *Earth Surface Processes and Landform* 34:398-412.

- 35 Matmon A, Bierman PR, Larsen J, Southworth S, Pavich M, Finkel R, Caffee M., 2003, Erosion of an ancient mountain range, the Great Smoky Mountains, North Carolina and Tennessee. *American Journal of Science* 303:817-855.
- 36 Meyer H, Hetzel R, Strauss H (2008) Erosion rates on different timescales derived from cosmogenic ¹⁰Be and river loads: implications for landscape evolution in the Rhenish Massif, Germany. *International Journal of Earth Sciences* 99(2):395-412.
- 37 Meyer H., Hetzel R., Fügenschuh B., Strauss H., 2010, Determining the growth rate of topographic relief using in situ-produced ¹⁰Be: A case study in the Black Forest, Germany. *Earth and Planetary Science Letters* 290(3-4): 391-402.
- 38 Morel P, von Blanckenburg F, Schaller M, Kubik PW, Hinderer M, 2003, Lithology, landscape dissection and glaciation controls on catchment erosion as determined by cosmogenic nuclides in river sediment (the Wutach Gorge, Black Forest). *Terra Nova* 15:398-404.
- 39 Nichols KK, Bierman PR, Finkel R, Larsen J., 2005, Long-term sediment generation rates for the upper Rio Chagres Basin: Evidence from cosmogenic ¹⁰Be, in: *The Rio Chagres: A Multidisciplinary Profile of a Tropical Watershed*. R.S. Harmon (ed.), Springer. 297-313.
- 40 Norton KP, von Blanckenburg F, Schlunegger F, Schwab M, and Kubik PW, 2008, Cosmogenic nuclide-based investigation of spatial erosion and hillslope channel coupling in the transient foreland of the Swiss Alps. *Geomorphology* 95:474-486.
- 41 Norton KP, von Blanckenburg F, Kubik PW, 2010, Cosmogenic nuclide-derived rates of diffusive and episodic erosion in the glacially sculpted upper Rhone Valley, Swiss Alps. *Earth Surface Processes and Landforms* 35:651-662.
- 42 Norton KP, von Blanckenburg F, Dibiase R, Schlunegger F, Kubik PW, 2011, Cosmogenic ¹⁰Be-derived denudation rates of the Eastern and Southern European Alps. *International Journal of Earth Sciences* 100(5):1163-1179.
- 43 Ouimet WB, Whipple KX, Granger DE, 2009, Beyond threshold hillslopes: Channel adjustment to base-level fall in tectonically active mountain ranges. *Geology* 37:579-582.
- 44 Palumbo L, Hetzel R, Tao M, Li X., 2010, Topographic and lithologic control on catchment-wide denudation rates derived from cosmogenic ¹⁰Be in two mountain ranges at the margin of NE Tibet. *Geomorphology* 117:130-142.
- 45 Palumbo L, Hetzel R, Tao M, Li X., 2011, Catchment-wide denudation rates at the margin of NE Tibet from in situ-produced cosmogenic ¹⁰Be. *Terra Nova*, 23:42-48.
- 46 Perg, L, Anderson, R, Finkel, R, 2003, Use of cosmogenic radionuclides as a sediment tracer in the Santa Cruz littoral cell, California, USA. *Geology*, 31:299-302.
- 47 Placzek, CJ, Matmon, A, Granger, DE, Quade, J, and Niedermann, S, 2010, Evidence for active landscape evolution in the hyperarid Atacama from multiple terrestrial cosmogenic nuclides. *Earth and Planetary Science Letters*, 295:12-20.
- 48 Quigley M, Sandiford M, Fifield LK, Alimanovic A, 2007, Landscape responses to intraplate tectonism: Quantitative constraints from ¹⁰Be nuclide abundances. *Earth and Planetary Science Letters* 261(1-2):120-133.
- 49 Reinhardt LJ, Hoey TB, Barrows TT, Dempster TJ, Bishop P, Fifield L, 2007, Interpreting erosion rates from cosmogenic radionuclide concentrations measured in rapidly eroding terrain. *Journal of Geophysical Research* 112:390-409.
- 50 Reuter J. (2005). Erosion rates and patterns inferred from cosmogenic ¹⁰Be in the Susquehanna River basin. University of Vermont M.Sc. Thesis. pp. 160.
- 51 Riebe CS, Kirchner JW, Granger DE, Finkel RC, 2000, Erosional equilibrium and disequilibrium in the Sierra Nevada, inferred from cosmogenic ²⁶Al and ¹⁰Be in alluvial sediment. *Geology* 28:803-806.
- 52 Riebe CS, Kirchner JW, and Finkel RC, 2003, Long-term rates of chemical weathering and physical erosion from cosmogenic nuclides and geochemical mass balance. *Geochimica et Cosmochimica Acta* 67:4411-4427.
- 53 Safran EB, Bierman PR, Aalto R, Dunne T, Whipple KX, Caffee M, 2005, Erosion rates driven by channel network incision in the Bolivian Andes: Earth Surface Processes and Landforms 30(8):1007-1024.
- 54 Salgado A, Varajão C, Colin F, Braucher R, Varajão A, Nalini H., 2007, Study of the erosion rates in the upper Maracujá Basin (Quadrilátero Ferrífero/MG, Brazil) by the in situ produced cosmogenic ¹⁰Be method. *Earth Surface Processes and Landforms* 32: 905-911.
- 55 Schaller M, von Blanckenburg F, Hovius N, Kubik PW, 2001, Large-scale erosion rates from in situ-produced cosmogenic nuclides in European river sediments. *Earth and Planetary Science Letters* 188:441-458.
- 56 Scharf TE, Codilean AT, de Wit M, Jansen JD, Kubik PW, 2012, Strong rocks sustain ancient postorogenic topography in southern Africa. *Geology* (in press).
- 57 Stock GM, Frankel KL, Ehlers TA, Schaller M, Briggs SM, Finkel RC, 2009, Spatial and temporal variations in denudation of the Wasatch Mountains, Utah, USA. *Lithosphere* 1:34-40.
- 58 ***Sullivan, CL, 2007, ¹⁰Be erosion rates and landscape evolution of the Blue Ridge Escarpment, southern Appalachian Mountains. University of Vermont M.Sc. Thesis, pp. 76.**
- 59 Tomkins, KM, Humphreys, GS, Wilkinson, MT, Fink, D, Hesse, PP, Doerr, SH, Shakesby, RA, Wallbrink, PJ, Blake, WH, 2007, Contemporary versus longterm denudation along a passive plate margin: the role of extreme events. *Earth Surface Processes and Landforms*, 32(7):1013.
- 60 Vanacker V, von Blanckenburg F, Hewawasam T, Kubik PW, 2007, Constraining landscape development of the Sri Lankan escarpment with cosmogenic nuclides in river sediment. *Earth and Planetary Science Letters* 253(3-4):402-414.
- 61 Vanacker V, von Blanckenburg F, Govers G, Molina A, Poesen J, Deckers J, Kubik P, 2007, Restoring dense vegetation can slow mountain erosion to near natural benchmark levels. *Geology* 35(4):303-306.
- 62 Vance D, Bickle M, Ivy-Ochs S, Kubik PW, 2003, Erosion and exhumation in the Himalaya from cosmogenic isotope inventories of river sediments. *Earth and Planetary Science Letters* 206:273-288.
- 63 von Blanckenburg F, Hewawasam T, Kubik PW, 2004, Cosmogenic nuclide evidence for low weathering and denudation in the wet, tropical highlands of Sri Lanka. *Journal of Geophysical Research* 109:1-22.
- 64 Wittmann, H, von Blanckenburg, F, Kruesmann, T, Norton, KP, Kubik, PW, 2007, Relation between rock uplift and denudation from cosmogenic nuclides in river sediment in the Central Alps of Switzerland. *Journal of Geophysical Research*, 112:F04010.
- 65 Wittmann H, von Blanckenburg F, Guyot JL, Maurice L, Kubik PW, 2009, From source to sink: Preserving the cosmogenic ¹⁰Be-derived denudation rate signal of the Bolivian Andes in sediment of the Beni and Mamoré foreland basins: *Earth and Planetary Science Letters* 288:463-474.
- 66 Wittmann H, von Blanckenburg F, Maurice L, Guyot JL, Filizola N, Kubik PW, 2011, Sediment production and delivery in the Amazon River basin quantified by in situ-produced cosmogenic nuclides and recent river loads. *Geological Society of America Bulletin* 123:934-950.

*** ¹⁰Be-10 data recalculated based on: Portenga EW and Bierman PR, 2011, *Understanding Earth's eroding surface with ¹⁰Be*. GSA Today, 21:4-10.**

Figure DR1 (Top): Plot of cumulative global slope averaged over 5 km and 50 km moving windows. Note that >90% of the Earth's surface slope is below 50 m/km, and the effect of averaging over smaller or larger spatial scales does not significantly change that figure. **(Bottom):** A comparison of the frequency distribution of slope values obtained for the entire globe excluding Greenland and Antarctica, using the GTOPO30 (1km resolution; red) and GMTED2010 (250m resolution; blue). Note how the two curves are near parallel suggesting that although topography is much smoother in GTOPO30, the relative proportions of the different topographic 'features' are maintained. With other words, on both DEMs, the Andes and the Amazon basin, for example, occupy the same amount of continental area – except that they are both represented with less detail in GTOPO30 than in GMTED2010. For information on GMTED2010, see: <http://pubs.usgs.gov/of/2011/1073/pdf/of2011-1073.pdf>

Table DR2: Previously published estimates of global fluxes of sediment to the ocean and continental denudation rates.

Reference	Sediment load (Gt yr ⁻¹)	Sediment yield (kg m ⁻² yr ⁻¹)	Denudation rate (mm k.y. ⁻¹)
Founier (1960) ^[1]	51.1	0.544	218
Kuenen (1950) ^[1]	32.5	0.346	138
Gilluly (1955) ^[1]	31.7	0.337	135
Jansen and Painter (1974) ^[1]	26.7	0.284	114
Pechinov (1959) ^[1]	24.2	0.257	103
Lvovich(1974) ^[2]	21.7	0.231	92
Safyahov(1978) ^[2]	21.3	0.227	91
Schumm(1963) ^[1]	20.5	0.218	87
Milliman and Syvitski (1992) ^[1,3]	20	0.213	85
Lisitsyn (1974) ^[2]	18.5	0.197	79
Holeman (1968) ^[1]	18.3	0.195	78
Goldberg (1976) ^[1]	18	0.191	76
Makkaveev (1981) ^[2]	17	0.181	72
Milliman (1981) ^[2]	16	0.17	68
USSR National Committee (1974) ^[1]	15.7	0.167	67
Pinet and Souriau, 1998 ^[5]	15.7	0.167	67
Dedkov and Mozzherin (2000) ^[2]	15.5	0.165	66
Sundborg (1973) ^[1]	15	0.16	64
Walling (1987) ^[5]	15	0.16	64
Walling and Webb (1983) ^[1]	15	0.16	64
Ludwig and Probst, (1996) ^[3]	14.8	0.156	62
McLennan (1993) ^[4]	14	0.149	60
Milliman and Meade (1983) ^[1,3]	13.5	0.144	58
Lopatin(1952) ^[1]	12.7	0.135	54
Harrison (1994) ^[5]	11.7	0.125	47
Wold and Hay (1990) ^[4]	10.9	0.116	46
Gregor (1970) ^[4]	10.5	0.112	45
Summerfield and Hulton (1994)	9.7	0.103.	41
Judson (1968) ^[4]	9.3	0.099	40
Syvitski and Milliman, 2007	8.7	0.093	37
Mackenzie and Garrels (1966) ^[1]	8.3	0.088	35
This work (endorheic basins removed)	4.4	0.047	19
Average	17	0.19	75

^[1] Values from References from Walling and Webb (1996)

^[2] Values from References from Jaoshvilli (2002)

^[3] Values from References from Ludvig et al. (1996)

^[4] Values from References from Wilkinson (2005)

REFERENCES:

- 1 Jaoshvili, S, 2002, The Rivers of the Black Sea, European Environmental Agency, Copenhagen.
- 2 Ludwig W, Probst J-L, Kempe S., 1996, Predicting the oceanic input of organic carbon by continental erosion. Global Biogeochemical Cycles 10:23–41.
- 3 Summerfield M.A. and Hulton N.J., 1994, Natural controls of fluvial denudation rates in major world drainage basins: Journal of Geophysical Research, v. 99, p. 13871-13883.
- 4 Syvitski J.P.M. and Milliman J.D., 2007, Geology, Geography, and Humans Battle for Dominance over the Delivery of Fluvial Sediment to the Coastal Ocean: Journal of Geology, v. 115, p. 1-19.
- 5 Walling DE, Webb BW, 1996, 'Erosion and sediment yield: a global overview'. In: Walling, D.E. and Webb, B.W. (eds): Erosion and Sediment Yield: Global and Regional Perspectives, IAHS Publication No. 236:3–19.
- 6 Wilkinson B, 2005, Humans as geologic agents: A deep-time perspective. Geology 33(3): 161-164.