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Sandstone versus conglomerate erosional landscapes - Why similarities? Why differences?

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Why similarities? Why differences?

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<tr>
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<tr>
<td><strong>Sandstones</strong></td>
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Motivation – aims – outline

Geomorphology of sandstone terrains still remains insufficiently understood, although significant advances have been made in the last two decades.

Much less we know about erosional landforms and landscapes in conglomerates, despite their often outstanding scenic value and close association with sandstones, in vertical successions and spatial coverage.

Aim: framework to compare erosional landscapes developed in both lithologies. Where are similarities, where are differences, and why?

1. Introduction
2. Sandstone landform diversity – rock control approach
3. Sandstone landform diversity – time and process approach
4. Conglomerate geomorphology
5. Minor relief features
6. Conclusions and outlook
Angular sandstone landforms

Zhangjiajie (Wulingyuan), China – dissected plateau in Devonian sandstones, famous for vertical cliffs up to 300-400 m high and hundreds of slender angular towers and spires.

Strong joint control – cliffs following joint faces

Block release along bedding planes
Rounded sandstone landforms

**Purnululu** (Bungle Bungle), Australia – residual massif in Devonian sandstones, flat-lying, with distinctive rounded shapes of towers and ridges, giving dome-like appearance.

Notable lack of cement between sand grains.

*Photo: R.W. Young*
Angular and rounded sandstone landforms next to each other

Wadi Rum, Jordan – dissected upland and inselberg landscape in a succession of terrestrial Cambrian sandstones
Lithology and structure

Disi Sandstone
- total thickness >250 m
- fluvial origin
- medium- to fine-grained sandstone
- thick beds

Umm ‘Ishrin Sandstone
- total thickness >300 m
- fluvial origin
- medium- and coarse-grained sandstone
- variable bedding thickness
- high iron content and ferruginous layers
Angular and rounded sandstone landforms next to each other

Central Europe (Poland/Czech Republic) – multi-storey tableland in Cretaceous sandstone of shallow marine origin

Angular shapes – quartzose sandstone

More rounded shapes – arkosic sandstone
Angular and rounded sandstone landforms next to each other – does only rock control matter?

Weathered top surface

Angular cliffs

Large-scale toppling
**Roraima** (Venezuela) – Precambrian quartzites

Conglomerates – lithology and structure

- coexistence of clasts of different size, cement of different composition
- bedding usually not as distinct as in sandstones, jointing typically sparse
Conglomerates – how do they disintegrate?

Dissolution and disintegration of cement → release of larger clasts

Kata Tjuta (the Olgas) – Australia

Photo: G. Nanson

Talus composed of individual clasts
Conglomerates – how do they disintegrate?

Major rock falls seem less common and are often initiated at conglomerate/weak layers interface where seepage is efficient.
Seeking reasons for similarities and differences

**Conglomerates**
- Cement dissolution and disintegration
- Clast-after-clast release
- Rounded slope shapes

**Weak sandstones**
- Grain-by-grain disintegration
- Subsequent surface weathering

**Strong sandstones**
- Joint and bedding plane focused weathering
- Block release
- Angular shapes
  - Controlled by the rate of cliff evolution and rockfall frequency

Angular shapes controlled by the rate of cliff evolution and rockfall frequency.
## Minor landforms – examples of structure-controlled convergence

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Conclusions and outlook

1. There are a number of distinct landform similarities between sandstones and conglomerates, but there are some differences.

2. Studies of sandstone landforms over the last several decades have increased our understanding of the geomorphology of this rock type. But further research is needed of the relationships of mass strength to landform shape, the effects of bedding and jointing, weathering and mechanisms of mass failure.

3. Relief in conglomerates, in places associated with sandstone sequences, is less well understood. Future investigation of conglomerate landforms should include studies of:
   • the differences caused by variations in the proportions of conglomerate clasts
   • differences between clast-supported versus matrix-supported conglomerates
   • mass-strength characteristics
   • the influence of groundwater flow on weathering and rock breakdown
Thank you very much!