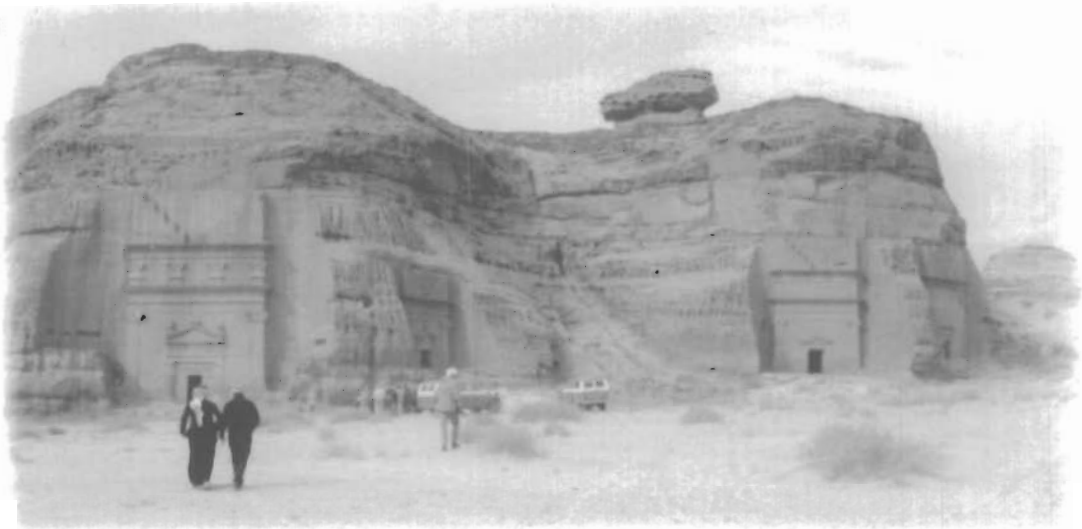


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Outcrop of current-bedded Cambro-Ordovician sandstone, here forming part of the Lower Saq Formation. The photograph, with Jack Oliver and Yannis Makris in the foreground, is from Medein Saleh in the Kingdom of Saudi Arabia. About two thousand years ago Nabatean people excavated large chambers in the sandstone and carved pilasters and other architectural ornaments on the exteriors of the excavations.



Tectonic Significance of the Accumulation of the Voluminous Early Paleozoic Reservoir-Containing Quartz-Rich Sandstones of North Africa and Arabia

About ten million cubic kilometers of quartz-rich sandstones were deposited close to sea level in the area presently occupied by North Africa and the Arabian peninsula between Middle Cambrian (c. 520 Ma) and Late Ordovician (c. 440 Ma). The preserved sandstones represent parts of a sheet that extended from Mauritania to Oman and from Guinea to the Atlas mountains (Burke and Kraus, 1998). This constitutes an area somewhat larger than that of the United States of America. It seems possible that the sandstones may have formed one of the largest bodies of siliciclastic sedimentary rock of a single dominant lithology ever to have been deposited on continental crust. The sandstones, which have an average thickness of about one kilometer, have been well-studied both at outcrop and in the subsurface, particularly in Algeria (Petroleum Frontiers, 1993, 1994) and in Oman (Droste, 1997). In both these areas the sandstones contain major oil and gas producing reservoirs.

I relate the deposition of this remarkable body of sandstones to the collapse and the erosion of mountains that had been constructed during the continental collisions which assembled western Gondwana at the end of the latest Precambrian during the Pan-African and Brazilian mountain building episodes (c. 650-550 Ma).

Two processes were involved:

1) An episode of tectonic escape, recorded in strike-slip faults and intracontinental rifts with ages clustering at c. 570 Ma. This process extended the crust of the North African and Arabian areas of the newly assembled continent of Gondwana by a factor of about two.

2) Thermal subsidence of the freshly extended crust followed. That subsidence led to the formation of an overlying, composite, sag or "steer's horns" basin in which most of the thick Cambro-Ordovician sandstones came to be deposited. The four million square kilometer West Siberian basin of Jurassic and Cretaceous age that overlies a set of Permo-Triassic, post-collisional, intra-continental rifts appears to have developed in a somewhat similar way (Sengor, 1995, especially Figure 2.4 and pages 64-65).

Cambro-Ordovician sandstones similar to those of North Africa and Arabia were also being deposited in other parts of Gondwana. Examples are now preserved in Pakistan, Iran, Turkey, Europe, the Cape fold belt, and South America. The area over which these comparable sandstones were deposited may serve to increase the estimate of the original extent of deposition. ⇒

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Weathering of Panafrikan rocks to produce the large volume of quartz-rich sandstones can be expected to have generated a comparable volume of fine-grained siliciclastic sediment. No such large volume of fine-grained sediment is preserved on the Gondwana continent, but giant accretionary wedges (such as that of the Lachlan fold belt of Australia, which were forming while the voluminous sandstones were being deposited) exemplify the kind of continental margin deposit into which material complementary to the North African and Arabian quartz-rich sandstones may have found its way.

A paucity of finer-grained intercalations among the sandstones of North Africa and Arabia may be attributable in part to the absence of vascular land plants during the Cambrian and Ordovician. In later times vascular plants and especially their

Planned illustrations to the presentation include a map, based on about 200 wells, showing variations in the thickness of the sandstones in North Africa. Slides will be shown of outcrop photographs of examples of Cambro-Ordovician sandstones from Medein Saleh in the Kingdom of Saudi Arabia. Nabatean antiquities, part of the Hedjaz railway, and effects possibly attributable to the activities of Colonel T.E. Lawrence may be discerned among the slides.

roots have impeded stream flow and fostered more general intercalation of finer-grained siliciclastic sediments among coarse-grained sediments.

The deposition of the vast Cambro-Ordovician quartz-rich sandstones of North Africa and Arabia was a closing episode in the extraordinary continental collision and mountain-building events that led to the final assembly of the great southern continent of Gondwana.

References

- Burke, Kevin and Jeffrey U. Kraus (1998) Are thick, quartz-rich, Cambro-Ordovician sandstone sequences in northern Africa and Arabia products of the collapse and erosion of huge, Pan-African, Tibetan-style plateaus? *Jour. Afr. Earth Sciences*, Vol. 27, no. 1A, p. 42.
- Droste, Henke H.J. (1997) Stratigraphy of the Lower Paleozoic Haima Supergroup of Oman. *GeoArabia*, Vol. 2, no. 4, pp. 419-472.
- Petroleum Frontiers* (1993) Ghadames basin of north central Africa. Vol. 10, no. 3, 49 pgs.
- Petroleum Frontiers* (1994) Ghadames basin and adjoining areas. Vol. 10, no. 4, 77 pgs.
- Sengor, A. M. C. (1995) Sedimentation and tectonics of fossil rifts, pp. 53-117 in Busby, Cathy J. and Raymond V. Ingersoll (editors) *Tectonics of Sedimentary Basins*. Oxford, England: Blackwell Science. 579 pgs. □

Reservation Code for this meeting is 5-0-3