

Petrographic analysis of Lower Cambrian sandstones from central Iran

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Lower Cambrian deposits are widespread in Iran. Iran was part of Gondwana at that time, and these deposits are broadly correlative with widespread basal Paleozoic clastic units that rest on cratons elsewhere in the world. The Lower Cambrian Lalun Formation in central Iran is less than 250 m thick and is divided into lower sandstone, middle shale, and top quartzite units. In the central area and elsewhere in Iran, the strata rest conformably on the Precambrian Zaigun Formation. The contacts between all units are conformable in central Iran but the lower sandstone and middle shale units are in unconformable contact elsewhere. Earlier studies suggested that the Lower Cambrian deposits formed in tidal flat to shoreface settings, but marine fossils have not been identified and the stacked sandstones are probably fluvial. The provenance is not known.

Petrographic analysis of ~200 sandstone samples from four sections through the formation indicates that the grains are mostly quartz (monocrystalline and rarely polycrystalline), feldspars, and in some samples lithic fragments of chert, metamorphic and rarely igneous origin. Accessory minerals include mica, and heavy minerals that include zircon, tourmaline, and opaque minerals are present in most samples. The sandstones have a wide compositional range from quartzarenite to arkose, feldspathic litharenite and rarely litharenite (chertarenite). Based on plots of feldspar, total quartzose grains, and total unstable lithic fragments, they were derived from craton interior, transitional continental, and recycled orogen sources.

The Lalun Formation sandstones experienced diagenetic events that included compaction and pressure solution, cementation (mostly by silica and rarely by carbonate, Fe-oxide, and clay), grain fracturing, and alteration of unstable grains. In most samples, feldspars are altered and replaced by authigenic carbonate and sericite, but in some samples clean feldspar grains occur. The feldspars locally underwent dissolution.