Framework Mineralogy, Diagenesis and Provenance of the Wajid Sandstone in Asir Region, Southwestern Saudi Arabia

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FINAL REPORT

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Several small isolated outliers on the Precambrian basement of the Arabian Shield represent the Wajid Sandstone at Abha and Khamis Mushyt area. This coarse-grained, highly ferruginous, cross-bedded, mineralogically matured sandstone formation overlies the peneplained Precambrian basement comprising of metamorphic and igneous rocks.

Multivariate statistical analyses of the geochemical data of the Sandstone suggest felsic igneous terrains located southwest of the study area (in Yemen) as the dominant source for these sediments. The southwesterly provenance is also indicated by the paleocurrent data of the cross-bedded sandstone units. The deduced source terrains and dispersion patterns of the Wajid Sandstone are not consistent with that of the younger clastic sequences in the area which show consistent progradation of the sediments from the highlands of the shield area in the west to the east. Minor contributions from the mafic igneous and low-grade metamorphic rocks in the vicinity were also recognized.

Heavy mineral distribution and clay mineralogy of the sediments corroborate the conclusions based on the trace element geochemistry. The geochemical and petrographical data also suggest intensive post-burial weathering of the sediments as a possible explanation for the mineralogical maturity of the sediments in the area.

The tuff-like horizons observed during the reconnaissance survey in the area are essentially kaolinite-rich claystone horizons. Both, authigenic and allogenic clays are present. The clay minerals found as pore-filling and pore-lining cement show well-preserved morphology. The preservation of delicate clay mineral morphology, rare occurrence of feldspar as framework grain suggests an in-situ, authigenic nature of the clay.

The present study reconfirmed good aquifer quality of the Wajid Sandstone. The porosity of the cored samples ranged from a low of 11.71% to a high of 22.68% (average 16.95%). Except for the permeability of two samples from Al Habalah location, the average permeability of the samples was below 20 md. Packing inhomogenity as evidenced by the presence of different kind of grain contacts suggests dissolution/degradation of certain framework grains and cement. Thin-section microsocopy shows clear evidence of replacement of calcite cement by ferruginous cement, precipitation of quartz crystallites around framework grains, and diagenetic alteration of feldspar grains.