

Extreme greenhouse conditions: Mesozoic examples of palaeoclimatic fluctuations from the southwestern margin of the Neotethys in the Salt Range, Pakistan

Iqbal, S.^{1,*}, Wagreich, M.¹, Jan, I.², Kürschner, W.³, Gier, S.¹

1) *Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria,*

**E-mail: siqbal_geol@yahoo.com*

2) *National Centre of Excellence in Geology, Peshawar, Pakistan*

3) *Department of Geosciences, Oslo, Norway*

The Triassic was generally dominated by warm-semiarid to arid palaeoclimate. However, palaeoclimatic reconstructions at the Triassic-Jurassic boundary indicate a prominent sea-level fall and change from warm-arid to warm-humid conditions in the Tethyan realm. In the Tethyan Salt Range of Pakistan a succession of Upper Triassic dolomites/green-black mudstones (Kingriali Formation), overlying quartzose sandstone, mudstones, laterites and Lower Jurassic conglomerates/pebbly sandstones (Datta Formation) provide information on the palaeoclimatic evolution and sea-level fluctuation of the area. Preliminary palynological results for the Kingriali Formation indicate dominance of pollens in the mudstones whereas spores are dominant in the Datta Formation. Clay mineralogy of the upper part of the Kingriali Formation (Rhaetian) indicates high illite to kaolinite ratio. The kaolinite content, a reflection of the advanced stage of chemical weathering and hence greenhouse conditions, increases up-section in the overlying sandstone-mudstone succession (Hettangian). The overlying laterite-bauxite horizons lack illite/smectite and are rich in kaolinite, boehmite and haematite. At places these kaolinite rich horizons are mined in the area (Western Salt Range). The bulk rock geochemistry of the succession confirms a similar trend. The Chemical Index of Alteration (CIA) displays an increasing trend from the Upper Triassic shales (CIA 75–80) through the overlying sandstones/mudstones-laterites to the overlying quartz rich sandstones and mudstones (CIA 90–97). The overall results for the succession reveal an increasing chemical maturity trend (increase in the intensity of chemical weathering) thereby supporting a change from warm-arid to a warm-humid palaeoclimate, probably extreme greenhouse conditions. During the late Mesozoic, a similar situation was established in the Salt Range, Trans-Indus Ranges and Kohat-Potwar Plateau. The Lower Cretaceous Chichali and Lumshiwai formations represent siliciclastic deposition on top of Middle Jurassic carbonates of the Samana Suk Formation. Striking similarities to the Datta Formation include: 1) both successions represent thick siliciclastic deposition on top of a carbonate platform, an indication of general sea-level fall, and 2) the sandstones in both the successions are texturally and compositionally mature quartz arenites deposited in warm-humid palaeoclimate of typical Mesozoic greenhouse conditions favouring chemical weathering.