

Late Ordovician Glacial and Glacio-Fluvial Paleovalley Architecture and Sedimentation in Southeast Jordan and Northwest Saudi Arabia

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ABSTRACT

Four recently discovered glacio-fluvial paleovalleys in southeast Jordan and northwest Saudi Arabia are described for the first time. The paleovalleys formed as a result of glacial erosion by series of sub-parallel valley glaciers during the Late Ordovician (Hirnantian) southern hemisphere glaciation on the Arabian Plate. The southwest-northeast orientation of the paleovalleys, Proterozoic erratic clasts and paleocurrent vectors indicate the advance of glaciers and subsequent glacio-fluvial siliciclastics emanating from a paleo-ice sheet located to the south on the Arabian Shield. U-Shaped, paleovalley cross-sectional morphologies and gently inclined longitudinal profiles indicate initial glacial erosion of the 'finger-like' paleovalleys, probably as wet-based valley glaciers, eroded up to 250 m depth into Late Ordovician marine bedrock formations. Paleovalley-fill sequences comprise a tripartite upwards succession: a) basal sandstone-dominated tillite with well-rounded, grooved and striated granitoid and metamorphic basement clasts derived from the Proterozoic Arabian Shield together with locally derived rounded and elongate boulders eroded from the local bedrock at the margins of the paleovalleys (Retrogradational Lowstand Sequence); b) green chloritic siltstone (Zarqa Formation) deposited during a progradational sea-level rise with marine influence (Transgressive Sequence); and c) coarse-grained, trough cross-bedded sandstone (Sarah Formation) attributed to progradational fluvial sedimentation as glacial outwash. Rapid sea-level rise during latest Hirnantian to Early Llandovery time resulted in marine flooding of the glacio-fluvial alluvial plain and deposition of organic-rich mudstones representing transgressive and high-stand sequences.