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Geochemical attributes of late Neoproterozoic Salt Range Formation, Pakistan: constraints on provenance, paleoclimate, depositional and tectonic settings

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ABSTRACT: Detailed geochemical analyses of clastic fraction of the oldest exposed Salt Range Formation in the famous salt producing region (Salt and Trans-Indus Ranges) Pakistan was carried out in order to understand provenance, paleoclimate, depositional and tectonic settings. Sandstone and shale samples of Salt Range Formation were analysed for major, trace and rare earth elements and various geochemical models and ratios were used to interpret. Geochemical analyses of both sandstone and shale fraction mostly display similar results and interpretations. The samples are classified as arkose, subarkose, litharenites and were sourced from felsic and/or intermediate igneous rocks. The sedimentation of the detritus was occurred in fluvial to restricted shelf conditions under arid to semi-arid and oxygenated climate conditions. The tectonic settings of the sediments were mainly Oceanic and Continental Island arcs as well as Active Continental margin.

Key words: geochemistry, evaporites, western margin of Gondwana, provenance, Salt Range Formation, clastic rocks

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1. INTRODUCTION

The latest Neoproterozoic–early Cambrian time was thought to be very significant in order to predict number of important geologic conceptions for example supercontinents position, their rifting and amalgamation, extension, subduction, subsidence of the crust (Meert and Lieberman, 2004; Collins and Pisarevsky, 2005; Bowring et al., 2007), volcanisms (Ramezani and Tucker, 2003; Allen, 2007), sedimentation and paleogeography of the basins (Kaufman and Knoll, 1995), evaporites (Warren, 2010) and paleoclimate conditions. Study of ancient evaporite deposits are quite significant for better understanding of the related global and local tectonics, nature of the basin, oxic or anoxic redox conditions and marine or non-marine origin (Schroder et al., 2003). Geochemistry of sedimentary rocks provides useful signatures about these facts. Geochemical signatures of clastic rocks for provenance analyses are routinely used to elucidate the basin evolution (Taylor and McLennan, 1985; McLennan et al., 1990, 1993). Geochemistry of major and trace elements of clastic rocks are important tools regarding source area composition, recycling, hydraulic selection, palaeoweathering as well as tectonic adjustment of the sedimentary basins (Nesbitt and Young, 1982; Bhatia and Crook, 1986; Fedo et al., 1995; Bauluz et al., 2000; Cullers and Podkovyrov, 2002; Armstrong-Altrin et al., 2004; Slack et al., 2004; Veizer and Mackenzie, 2005; Etemad-Saeed et al., 2011), because of certain trace elements (like Sc, Th and REE)) are resistant during sedimentation processes and hence are introduced to sedimentary basin and better representing the provenance (McLennan et al., 1990). Argillites (e.g., mudstone and shale) exist as the most dominant detritus representing the mean crustal composition of the source regime (Nagarajan et al., 2007; Lee, 2009). The trace elements for instance Th, Cr, La, Y, Sc, Zr, Hf and Nb are favourable for determination of tectonic setting and provenance because of their comparatively low mobility throughout sedimentation (McLennan et al., 1983). Thus their relative distribution

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