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Uranium Distribution in the Lacustrine Calcareous Clastic-Evaporite Sequence in the Western Qaidam Basin, and Implications for U Behavior in Concentration of Closed Water

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Uranium (U) provides especially useful information for reconstructing paleoredox conditions due to its unique geochemical properties and behavior in supergene environments. The proxy potential under suboxic-oxic conditions associated with salinization of surface water in closed hydrologic systems, however, has not been adequately explored. This study examines the abundance and distribution of uranium in a sedimentary sequence of calcareous lacustrine clastics and salt layers from a high quality (938.5 m-long) core drilled in the western Qaidam Basin, NE Tibetan Plateau.

The core SG-1 consist of fine grained calcareous lacustrine sediments intercalated with salt layers that increase upward, provides an excellent opportunity for studying the uranium geochemistry during the basin's long-term sedimentary evolution. The core has been precisely dated from 2.77 Ma to 0.1 Ma (Zhang et al., 2012a), providing a well archive of Quaternary climatic drying in inland Asia deduced from grain sizes and lithofacies (Wang et al., 2012), clastic and salt minerals (Li et al., 2010, 2013), as well as elemental geochemistry (Yang et al., 2013a; 2013b). Wang et al. (2012) and Yang et al. (2013b) reconstructed lake level fluctuations from the oxygen-deficient semi-deep/deep brackish lake that existed at the lower part to the oxygen-enriched shallow saline-playa lake intercalated with salt layers at its upper portion based on detailed lithologic investigations and manganese geochemical records. These previous studies impose strong constrains on the interpretation of the uranium data and its usefulness as a paleoredox proxy within the core.

U concentrations in calcareous clastic sediments (including carbonate, siliclastic fractions as well as iron and

manganese oxides / oxyhydroxides fractions) and salt layer are examined. In the calcareous clastic sediments, variations of the uranium concentrations in siliclastic fraction accord with lake level fluctuations reconstructed by lithology investigation, providing tools for tracing redox conditions in paleolake bottom water. The uniform variation of carbonate content, U and Sr concentrations in carbonate fraction demonstrate carbonate precipitation minerals and their abundance control of U distribution in carbonate fraction. In the salt layers, U and Al concentrations are tightly related, implying both are mainly derived from detrital fraction in the salt layers. However, the enrichments of U and Mg are systematically higher in the salt minerals formed in more concentrated brine and lower in those formed in less concentrated brine. We propose that during the stage of carbonate precipitation, carbonate could effectively remove U from lake water; during the subsequent stage of salt minerals precipitation, due to lack of effective remove processes, U behavior is similar with Mg, in favor of being as dissolved forms in the saline water, giving rise to increased U enrichments in the more concentrated brine and the corresponding precipitated salt minerals.

Key words: Uranium; Paleoredox conditions; Lacustrine sediments; Evaporite; Qaidam Basin

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