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The mixing process of mixed siliciclastic-carbonate-tuffaceous sedimentary rocks in saline lacustrine basin

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Researches on mixed siliciclastic-carbonate rocks in shallow marine have been already well-developed, while the formation theory and practical application of mixed rocks in saline lacustrine are rarely investigated. This study aims to explain systematically the lithological associations, distribution characteristics, mixing sedimentary processes, and its depositional model, taking Lucaogou Formation in Jimusaer Sag, Junggar Basin as an example. Generally speaking, the mixed rocks refer to the mixtures of siliciclastic materials and carbonates during the process of sedimentation. However, Lucaogou mixed rocks were more complicated due to addition of large amounts of volcanic tuffaceous materials. Therefore, a previously undocumented type of mixed siliciclastic-carbonate-tuffaceous sedimentary rocks is introduced and discussed. The classification system and mixing sedimentary processes are modified and improved herein, enriching the theoretical system of mixed sedimentation.
The lithologies of Lucaogou were very complicated, and various lithological associations have developed in different mixing processes. Facies mixing was one of the most common types, mainly consisting of fine-sandstone, dolomitic siltstone, silty dolomite/limestone and dolomicrite from lake margin to center in sequence. Punctuated mixing was always related to storm events but infrequently developed. It usually brought fine-sandstone or tuffaceous siltstone in sandy shoal into deeper water argillaceous limestone, dolomitic mud and dolomicrite environment. In-situ mixing tended to develop in semi-deep water, and it was often biolithite and algae dolomite interbedded in terrigenous mudstone and siltstone. Additionally, bioclastics, intraclasts and oolites were found in strong hydrodynamic condition, then admixed with siliciclastic matrix, and formed another type of in-situ mixing. Sourcing mixing was newly explained based on the three end-member mixed system, expanding the concept proposed by Mount (1984). In Lucaogou, it was identified as a new type of source mixing process when the tuffaceous materials, mostly transported by wind, mixed with terrigenous clastics. Therefore, it mainly consisted of large set of mudstones interbedded with thin layer tuff and sedimentary tuff near the lake-basin center, and dolomitic siltstone, tuffaceous siltstone and dolomicrite highly intermixed with tuff near lake shore. According to lithological associations, mixing process and sedimentary microfacies, the depositional model has been established for Lucaogou multi-source mixed rocks.