

Mineralogical and Geochemical Characteristics of Hydrocarbon-Bleached Rocks in the Baiyanggou Mud Volcano, Xinjiang, Northwest China

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Abstract

Hydrocarbon seepage from petroleum-related mud volcanoes can induce near-surface redox zones that modify certain chemical and mineralogical features in surface rocks. A total of 11 samples were systematically collected along the main route of fluids flowing on the Baiyanggou mud volcano, and determined for the mineralogical and chemical compositions as well as iron species using XRD, XRF and Mössbauer spectroscopy, respectively. Overall, the results clearly indicated the spatial variations in most geochemical parameters induced by redox fluctuation processes around the Baiyanggou mud volcano. At a close range of the mud volcanic craters, the bed/host rocks were in greyish color and their iron species were dominated by ferrous iron, mostly in chlorite and muscovite (para-Fe²⁺), with some portion of ferric hydroxide and ferric iron in clay minerals (para-Fe³⁺), indicating strong reductive characteristics. Along with the distance increased from the craters, the relative contents of reducing iron (Fe²⁺) in the bed rocks were gradually decreased, and the reddish bed rocks contained relatively high contents of para-Fe³⁺ and ferric iron in hematite (hem-Fe³⁺). A redox transitional zone occurred at a certain distance from the active mud volcanic craters, in which sharp changes of iron-bearing minerals could be tracked. The reducing and weakly alkaline medium contributed to the precipitation of secondary carbonate minerals such as calcite and siderite. Geofluids represented by brackish waters, gases and oils tend to migrate through sandy veins or horizons in clay

sequence, faults and fracture networks with relatively high porosity and permeability. Iron speciation of bed/host rocks can be used as a tracer for the migration of reducing geofluids.