Iron speciation of mud breccia from Dushanzi mud volcano in Xinjiang Province, NW China

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As a specific type of hydrocarbon leaching system, mud volcanoes have various important implications in petroleum exploration, seismic monitoring, and research on environmental issues and atmospheric emission of greenhouse gases etc. In order to obtain a better understanding of the complicated organic-inorganic interactions in the continental mud volcano system, especially from the view point of chemical speciation of redox sensitive elements, seven mud breccia samples were collected from one crater and outflow of the Dushanzi mud volcano, and one original reddish country rock sample far from the crater for comparison. All the samples were analysed for their mineral and chemical compositions, and iron species by means of X-ray diffraction, X-ray fluorescence spectrometer, and Mössbauer spectroscopy, respectively.

The analytical results showed systematically variations in their mineral compositions and major elements and loss on ignition as well as iron species along with petroleum bleaching effect on the original rocks, through which the oil, gas, water, and probably also mud were migrated, mainly including: (1) some specific transformation of clay minerals such as smectite into illite, chlorite and/or muscovite along with the precipitation of secondary carbonate minerals like calcite, dolomite, and siderite; (2) associated silicon depletion and significantly enrichment of iron, manganese, magnesium, calcium and phosphorus; (3) conversion of iron species from ferric into ferrous along with colour changes of the host rocks from original reddish into grey and even black as the rocks altered.

In summary, along with hydrocarbons bleaching, the oxidation of methane and other hydrocarbons into carbon dioxide and even the precipitation of secondary carbonate would be favourable to reduce greenhouse emission and effect on the atmosphere from mud volcano systems in comparison to the whole or original methane and other greenhouse gases directly emitted to the atmosphere. Such special geological or geochemical processes would be considered as a new conception as carbon fixation in the mud volcano system.