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Natural Gas Seepage Sedimentary Ore-forming Model in Manganese Rift Basin

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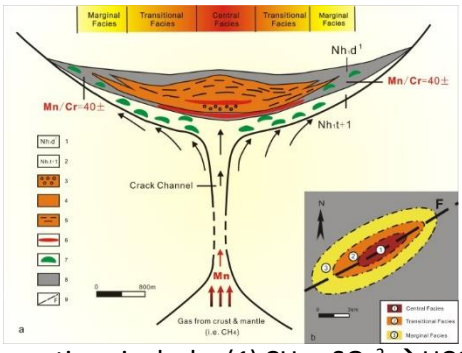
Rhodochrosite ore deposits in the early Nanhua period of the Neoproterozoic in the Guizhou-Hunan-Chongqing area represent a new type of manganese deposit: natural gas seepage sedimentary manganese deposition in a rift basin. This new type of deposit formed in the Nanhua rift basin during the break-up of Rodinia, which was driven by the re-extension of the Yangtze and Cathaysia blocks ca. 780 Ma. From ca. 725 Ma, the Nanhua basin further broke into two secondary rift basins: the Wuling and Xuefeng basins. Large-scale manganese mineralization occurred ca. 660 Ma, during which the Daotuo and Xi'xibao manganese deposits formed. This type of manganese deposit belongs to a unique rift basin metallogenic system which formed via a coupling process of both interior and surface sub-systems. The synsedimentary faults are not only the channels through which deep manganese and ancient natural gas rise but also the link of the two subsystems metioned above. Three ancient natural gas seepage extravasation facies (central facies, transitional facies and marginal facies) have also been found along the synsedimentary faults in the center of the graben basin.

***Figure**: Metallogenic model of ancient natural gas seepage sedimentary manganese ore (a-profile; b-plan figure)*



Manganese and hydrocarbon gas/fluid came from the deep along fractures and rose to shallow parts of the crust and aggregated slowly, which was followed by the formation of a high pressure reservoir of manganese and hydrocarbon fluid. A thermal sulfate redox reaction led to the formation of a series of anoxic oxidation of hydrocarbon gas such as methane. These reactions include: (1) $CH_4 + SO_4^{2-} \rightarrow HCO^{3-} + H_2S(HS^-) + heat$; (2) hydrocarbon $+ SO_4^{2-} \rightarrow HCO^{3-} + H_2S(HS^-) +$ (organic acid, light oil gas) + solid asphalt + water + heat; (3) $Mn^{2+} + 2HCO^{3-} \rightarrow Mn(HCO_3)_2 \rightarrow MnCO_3$(precipitation) $+ H_2O + CO_2$(gas). These processes led to the production of rhodochrosite and its upwelling along the synsedimentary channels to the center of the graben basin and then to deposition.

References:

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