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Potential for deformed volcanogenic manganese deposits in southern Mongolia

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A series of manganese occurrences are located in the Khutag uul island arc terrane of southern Mongolia. The area is dominated by volcanoclastic and carbonate strata of the Lower-Middle Devonian Burged khar uul Formation. These strata were deformed by folding and plastic deformation to form a rotational "Z" like anticlinal structure. Igneous rocks are very limited in the area, only outcropping locally in the northeastern corner. These granitoids, with some gneissic textures, were defined as part of the Late Devonian Khatanbulag intrusive complex.

The ore-bearing section is recognized in 356 drill holes and the sequence is confirmed by geophysical surveys as well. The upper volcanics are more mafic in constituents and petrographic analysis proves that they are metabasites or dolerite. The middle limestone is characterized by re-transported calcarenite and is often oolitic textured and contains deep water crinoid fossils, which suggest that it is different from continental shelf limestones. The lowest units are deep sea facies clayey shales. The depositional transition from the turbidite-like lagoon facies black shales, carbon-rich siltstone, and argillites to the deep sea facies clay and fine materials sets the conditions for the sedimentary manganese mineralization.

There are seven manganese prospects in the area. The ore-bearing sequence consists mostly of deep sea facies manganese-bearing limestone, manganese lenses, and concretions containing clayey shale horizons with limestone, calcarenite, and crinoidal limestone. They are discontinuous and constrained in the manganese-bearing productive horizons, which generally span over 11000 m length along strike, and are 150-300 m wide in the dip direction. Former studies have revealed that the sedimentary manganese occurrences formed in a normal geological setting. However, manganese nodular and lenticular mineralization is unevenly distributed. The average grade in carbonate rock-hosted manganese ore is at 3.5-8.6%, while in concretions and lense-like massive manganese ore grades at 18%-21% Mn. The ore-bearing strata underwent intense compressional plastic deformation caused by the NW40°-50°-striking right lateral strike-slip faulting. The strain zones observed in post-manganese veins developed from the compressional and extensional forces caused by these fault zones on the manganese nodulars and lenses and remobilizing some manganese into structures. The beds are mostly composite blocks due to brittle deformation. Also the sequence experienced intense latitudinally-striking northeast folding, with northwest, north, and southeast striking shallow dips along syncline and anticline fold limbs, andat the fold axes they are even horizontal.

A preliminary AMT profile has revealed a possible hidden intrusion at depth, which aided in the deformation and folding of the strata. Considering the metallogenic setting, widely distributed silicification, and numerous manganese prospects, it is suggested that high-grade manganese orebodies and/or massive sulfide deposits are expected to occur under cover in much of the area.