Geology, petrology, geochemistry, and economic potential of a Neoproterozoic to Triassic accreted terrane, in southern Sukhbaatar Aimag (province), south-eastern Mongolia

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The southern Sukhbaatar Aimag (province) in southeastern Mongolia is a collage of Paleozoic to Lower Jurassic accreted island-arc and oceanic terranes and Precambrian cratonic basement, that were amalgamated between Neoproterozoic and Triassic times. This study investigates an 11x8 km area in the southeastern portion of the Nuhetdavaa Terrane, a Neoproterozoic to Lower Jurassic sequence of marginal sedimentary rocks, thick volcanic rocks, and late plutonic rocks, which are interpreted to represent mainly back-arc environments. This study describes the preliminary results of field, petrographic, and geochemical studies aimed at elucidating the petrogenetic, metallogenetic, and tectonic history of this poorly understood but economically and scientifically important area.

Three unconformity bound packages of rock occur in the field area: metasedimentary rocks of probable Early Paleozoic age form a basement to a package of Late Paleozoic bimodal volcanic rocks, which are separated from recent (Triassic?) shales and conglomerates by another regional unconformity. The metasedimentary and volcanic units are intruded by several medium sized granite and diorite stocks which are coeval with the Late Paleozoic volcanic rocks. The metasedimentary rocks are hornfelsic which are composed of alternating green, and dark gray layers. They are fine-grained and composed of mosaic quartz and alkali and plagioclase feldspar with minor hornblende and biotite porphyroblasts. Accessory apatite, zircon, and titanite are also present. Quartz and muscovite porphyroblasts are abundant near intrusive contacts. Felsic volcanic rocks occur as coherent domes composed of flow banded, quartz phyric rhyolite which rapidly grades into aphanitic spherulitic rhyolite with abundant lithophysae. Bimodal volcanism is indicated by the spatial association with vesicular basalt. Coeval intrusive rocks are represented by granitoids ranging from diorite to tonalite to 2-mica leucocratic granite. Diorites are fine- to coarse-grained and have characteristic glomeroporphyritic, optically zoned hornblende, ranging from 2 mm to 1.5 cm in length. Plagioclase compositions range from andesite to albite; these crystals are typically altered to sericite. Field relationships suggest that granite emplacement postdated the dioritic intrusive event.

Geochemically, rhyolite and granite have similar compositions with a strong negative slope on a primitive-mantle normalized multi-element diagram $(Th/Sm = 19.97)_{N,\,a}$ strong negative Nb and Ti anomaly and flat Dy - Lu slope. Rhyolites have slightly elevated levels of incompatible elements with respect to granites. Diorites have a slight negative Th - Sm ratio, positive Th anomaly and flat Ti to Lu slope.

The northeast-trending Zuunbayan sinistral strike-slip fault bisects the field area and separates it from the highly economic and potentially coeval rocks of the Oyu Tolgoi Cu Au porphyry deposits situated in similar geological terrane approximately 450 km to the southwest. The occurrence of vuggy miarolitic rhyolite and associated granites in a flow-dome setting spatially associated with structurally controlled chalcedonic quartz veins and breccia exposed over several kilometres indicate an environment favourable for epithermal-type mineral deposits. The alkaline volcanic and intrusive rocks that are dominant in the field area are analogous to those at Oyu Tolgoi and other world-class porphyry systems.