Geochemistry of volcanic and plutonic rocks from the southern Musoma-Mara greenstone belt: Implication for the evolution of the Tanzania craton

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The Neoarchean Tanzania craton contains patches of greenstone belts set in granitoid masses that occupy a large percent of the craton. Because of limited geological, geochronological and geochemical information, very little is known about this craton and its constituent terrains. We report new U-Pb chronological, Nd-Hf isotopic and major and trace element data for volcanic and granitoid rocks from the southern Musoma-Mara greenstone belts of the Northeast Tanzania craton. The volcanic rocks are mainly basaltic with minor felsic volcanic rocks. The intrusive rocks are mostly granodiorites and granites with few trondhjemitic samples. Geochemically, the basalts are tholeiitic and MORB-like but with minor depletions of Nb and Ti relative to N-MORB. The felsic volcanic and granitoid rocks are calc-alkaline with normal arc to adakitic signature. The basalts yielded a Sm - Nd isochron age of 2842 ± 65 Ma (εNd = +2.1, MSWD = 1.6) and εHf_{2840} = +1.7 - +3.2. One granitoid yielded U-Pb zircon age of 2689 ± 12 Ma which is similar to those reported for the oldest rocks in the North Musoma-Mara greenstone belt [1], and is interpreted to represent the age of granitoids and felsic metavolcanic rocks. The felsic volcanic rocks have εNd_{2689} ~ +1.6 - +2.5 and εHf_{2689} ~ +0.1 - +1.6 that are within error of those for granitods and meta-basalts. Collectively, these data show that the basaltic rocks may not be related to the felsic volcanic and intrusive rocks by fractionation but were likely formed from equally depleted sources, possibly in arc-back arc environment. The spatial association of MORB-like tholeiites and arc-like volcanic and granitoid rocks is not uncommon in the Tanzania craton [2], as well as other late-Archean cratons worldwide [3, 4], and may imply that the tectono-magmatic processes that produced this association were widespread during this period.

[1] Manya *et al*. (2006) *JAES* **45,** 355 - 366, [2] Manya (2004) *JAES* **40,** 269-279 [3] Kerrich *et al*. (2008) *Lithos* **101,** 1-23. [4] Yamashita *et al*. (2000) *Pre. Res*. **99,** 197-224.

Galactic chemical evolution and the short-lived radioactivities

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Nucleosynthesis in stars over roughly seven to eight billion years of Galactic history created the Solar System's supply of isotopes of carbon and heavier elements. Over those seven to eight billion years, the isotopic composition of the interstellar medium became increasing enriched in heavy elements as nucleosynthesis in one generation of stars built upon the composition of the previous generation. This build up is known as Galactic chemical evolution (GCE). In general, to study Galactic chemical evolution, one constructs models based on a rate for infall of metal-poor gas to build up the Galaxy, an appropriate star formation rate, and stellar nucleosynthetic yields. One then follows the time evolution of the mass fractions of the isotopes in the interstellar medium (ISM) (e.g. [1]).

The abundance of the short-lived radioactivities in the early Solar System may be analyzed in the context of Galactic chemical evolution models. In a chemical evolution model with infall, one may compute the average ISM ratio of the abundance of a radioactive species to its stable reference isotope [2]. One may then apply more sophisticated models that divide the ISM into multiple phases (e.g. [3, 4]). When one compares the abundance ratios of short-lived species to their stable reference isotopes in the molecular cloud phase (the phase in which the Sun is thought to have formed) of the multi-phase models to the values inferred for the early Solar System, one finds that ^{53}Mn, ^{146}Sm, and ^{182}Hf are in line with expectations from ongoing nucleosynthesis; ^{107}Pd, ^{129}I, and ^{244}Pu are low and apparently require a decay interval; and ^{26}Al, ^{36}Cl, ^{41}Ca, and ^{60}Fe are high and probably require injection from a nearby supernova [4].

To facilitate study of this issue, we have developed an online tool for analyzing the abundances of radioactive species in the phases of the ISM. It is the Three Phase ISM Tool available at http://www.webnucleo.org/. We are also developing full multi-dimensional GCE codes that we will make freely available at the above web site.

[1] Timmes *et al.* (1995) *Astrophys. J.* **98,** 617-658. [2] Clayton (1984) *Astrophys. J.* **285**, 411-425. [3] Clayton (1982) *Astrophys. J.* **268**, 381-384. [4] Meyer & Clayton (2000) *Space Sci. Rev.* **92**, 133-152.