Dating the first stage of planet formation via Mn-Cr chronometry

F. MOYNIER[1,2], Q.-Z. YIN[1] AND B. JACOBSEN[1]

[1]Dept. Geology, University of California, Davis, CA 95616
[2]Earth Planet. Sci., Washington Univ., St. Louis, MO 63130

Stage-I is the least understood among the three stages of planet formation because there are very few observational constraints and the physics of grain growth in the solar nebula from micron-sized particles to kilometer-sized bodies is not well understood. Here we use ^{53}Mn-^{53}Cr isotopic records discerned from primitive meteorites to constrain the timescale of stage-I of planet formation [1]. Carbonaceous chondrites are cosmic sediments made of refractory materials such as Ca-Al-rich inclusions (CAIs), and chondrules (molten silicate droplets) that are “cemented” together by fine grained dust materials rich in organics and presolar grains. The preservation of organic matter and pristine presolar grains in the matrix testifies that the parent bodies of the carbonaceous chondrites were never heated to high temperatures. Therefore their size were on the order of a few kilometers to <20km at most to effectively dissipate heat. Thus the parent bodies of carbonaceous chondrites can be regarded as products of stage-I of the planet formation. We demonstrate that all carbonaceous chondrites exhibit $^{53}Cr^*$ anomalies that are correlated with $^{55}Mn/^{52}Cr$ ratio. By comparing the resulting initial $^{53}Mn/^{55}Mn$ ratio of $(8.5\pm1.2)\times10^{-6}$ with the $^{53}Mn/^{55}Mn$ ratio of angrite LEW86010 and its absolute Pb-Pb date, an absolute age of $4568.0^{+0.91}/_{-1.17}$ Ma for the carbonaceous chondrite is derived. This age is very similar to Pb-Pb ages obtained on CAI fragments (4567.2 ± 0.6 Ma) from the CV3 chondrite Efremovka [2]. The age deduced from the initial $^{53}Mn/^{55}Mn$ ratio for the bulk carbonaceous chondrites is the same as that for the CAIs, therefore the formation of the first solid igneous objects as well as the accretion of the undifferentiated kilometer-sized carbonaceous chondrite parent bodies must have been complete within +0.91 to -1.17 Ma at 4568 Ma ago. This is currently the best estimate for the stage-I planet formation timescale.

[1] Moynier *et al*. (2007) *ApJL* **671,** L181-L183. [2] Amelin *et al*. (2002) *Nature* **297**, 1678-1683.

Aerogeophysical, geological and geochemical investigation of the Late Archaean granitoids in the Musoma-Mara Greenstone Belt, NE Tanzania

E. MSHIU, M.A.H. MABOKO AND I. MAROBHE

Department of Geology, University of Dar es Salaam, P.O.Box 35052, Dar es Salaam, Tanzania (mshiutz@gmail.com)

The Musoma Mara Greenstone Belt (MMGB), is among the six greenstone belts forming the Archaean Tanzania craton.This belt is intruded by syn-to-post orogenic granitoid suites which range in composition from Tonalite Trondhjemite Granodiorites (TTG) to granite.

Based on the analysis and interpretations made on high resolution airborne radiometric data as well as previous geological maps, a geophysical interpretation map was obtained. This map broadly categorized the MMGB granitoids into two types: the first type is characterized by high contents of K, U and Th, whereas the second type is characterized by high K relative to U and Th. The aeroradiometric interpretation map was used as a base map for ground follow-up whereby the granite types were sampled accordingly for geochemical analysis. Geochemical data from the granitoids confirmed the two radiometrically classified granites which are high-K granites and Tonalite Trodhjemite Granodiorite (TTG). The high-K granites were further subdivided into biotite and calcic granites.According to the geophysical interpretation map, biotite-granites and calcic-granites correspond to the aerogeophysical high K, U and Th granite type whereas the TTG precisely correspond to the high K, low U and Th granite type.

Biotite granites showed high content of K_2O (mean = 5.1 wt %), low Mg # (mean = 25), low CaO (mean = 1.14) and moderate alkali affinity with an average Na_2O+K_2O value equals to 8.5 wt %. Similarly, calcic granites are high in K content (K_2O, mean = 4.8 wt %), high Mg # (mean = 42), also high CaO (mean = 1.9). TTG showed, high Mg# (mean = 47), Al_2O_3 > 13 %wt, Yb<1 ppm, La/Yb > 30, Na_2O/K_2O >1 with both Sr and Ba >500 ppm. Biotite and calcic granites are interpreted to have been generated from re-melting of the TTG and intermediate to felsic volcanic rocks in a subduction related environment whereas TTG were formed by partial melting of garnet amphibolites in a Neoarchaean Andean-type convergent margin.