LARGE METEORITIC IMPACT ON ANTARCTIC ICE SHEET 434 KYR AGO – MICROMETEORITES FOUND IN THE DOME FUJI ICE CORE.

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Introduction: Two distinct highly concentrated particles layers are found in the Dome Fuji (77˚19'S, 39˚42'E) and the EPICA-Dome C (75˚06'S, 123˚21'E) ice cores, Antarctica [1, 2]. The two layers are 434 kyr and 481 kyr old, respectively, based on the ice core dating. These two ice cores are separated by ~2,000 km. Analyses of mineralogy, petrology, and bulk chemical composition indicate that these particles may be extraterrestrial [1, 2].

Cosmogenic Radionuclides: Five large particles were hand picked from the upper layer of the Dome Fuji ice core at the depth of 2641 m. Cosmogenic ^{10}Be ($t_{1/2}$=1.36 Myr), ^{26}Al (0.705 Myr), and ^{36}Cl (0.30 Myr) in individual particles (30-70 µg) were measured by AMS at Purdue University. Four out of the 5 particles contain 2.5-4.2 dpm/kg of ^{10}Be [3]. None of the particles contain ^{26}Al ($\leq 1 \times 10^4$ atom) or ^{36}Cl ($\leq 1.4 \times 10^4$ atom), levels indistinguishable from the chemistry blank.

Discussion: In previous work, we favored a the hypothesis that ^{10}Be detected in the Dome Fuji particles was produced in space, however we could not exclude the possibility of terrestrial ^{10}Be contamination [3]. However, the observed activity ratios of ^{26}Al/^{10}Be in these particles are <0.2; the production rate ratio in space is ~3. The lack of cosmogenic ^{26}Al indicates that ^{10}Be was inherited from the Antarctic ice by impact on Antarctic ice sheet. Since major elemental abundances relative to CI chondrites are 0.6-1.5 (except some volatile elements) [1], an impact on a continent or in the ocean is excluded. Assuming the ^{10}Be concentration of the ice sheet was (0.5-2) x 10^5 atom/g at 434 kyr ago, the observed ^{10}Be concentration in 4 particles accounted for by less than a few g of melted ice. This implies that the mass of melted ice was more than 10^4 times that of the particles. Oxygen isotopic compositions of olivine in two particles from this dust layer fall along the terrestrial fractionation line and reach up to δ^{18}O=-47‰ [1]. The light oxygen isotopes might be indicative of exchange with ice at the impact site.

Impact on the ice. Based on the existing evidence we favor a scenario in which a large chondritic object, >100 m in diameter, impacted on the Antarctic ice sheet 434 kyr ago. The projectile interacted with ice and trapped ^{10}Be (and possibly ^{36}Cl) from the ice. The ^{10}Be was concentrated by evaporating melted ice, while the void spaces and quenched texture of the particles were produced by impact heating. Some volatile elements, noble gases, and terrestrial ^{36}Cl contamination in the ejected particles were lost by heating. Since the ejecta was not contaminated with bedrock, the impact site must have been inland where the ice is thick. We further speculate that the projectile size was not a ~km sized object. It might be possible to find the site by techniques such as ice penetrating radar but there are currently no other ice cores available that reach older than 434 kyr.

References: [1] Misawa K. et al. 2008. *39th Lunar and Planetary Science*:#1690. [2] Narcisi B. et al. 2007. *Geophysical Research Letters* 34:L155022. [3] Nishiizumi K. et al. 2008. *39th Lunar and Planetary Science*:#2231.