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THE AGE OF THE MONTURAQUI IMPACT CRATER

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Introduction: The Monturaqui crater is the only meteorite impact related structure yet found in Chile. The simple crater of ~400 m diameter and ~34 m of depth [1] is localized at 3015 m altitude in the precordillera near the southern end of Salar de Atacama. The crater age was estimated as older than 0.1 Ma with an appreciable error by [2] by thermoluminescence analysis. We are reporting the first absolute ages of the Monturaqui impact following two approaches: a) the terrestrial age of the impactor by measuring the residual activities of ^{10}Be, ^{26}Al, ^{36}Cl, ^{41}Ca, ^{59}Ni, ^{60}Fe, and ^{53}Mn in iron shale samples, which corresponds to the altered fragments of the impactor (coarse octahedrite—group I—deduced from Fe-Ni-spherules found in impact melt ejecta [2,3]), and b) surface exposure ages by measuring in situ produced ^{10}Be in the granite outcrops exposed to cosmic radiation on Earth.

Experimental: Accelerator mass spectrometry of ^{10}Be and ^{26}Al took place at ASTER, ^{36}Cl at CAMS, and ^{53}Mn at the Maier-Leibnitz-Laboratory. Other nuclides are foreseen soon.

Results: Measured concentrations are compared with depth-depending production rates (PRs) from theoretical Monte-Carlo calculations [priv.com., I. Leya]. As these PRs are based on the chemical composition (in space), remaining fragments are highly altered and precise chemical analyses could not yet be achieved, certain assumptions are influencing the discussion of our, thus preliminary, data.

The longest-lived radionuclide ^{53}Mn ($t_{1/2}$ = 3.7 Ma), normalized to a fully corroded Fe_2O_3-sample, is the least sensitive nuclide to a varying terrestrial age, thus, providing us with the best value for a shielding depth: 62–71 cm. The best fit of the measured shortest-lived radionuclide ^{36}Cl ($t_{1/2}$ = 0.3 Ma) with theoretical PRs at that depth is for a terrestrial age of 500–600 ka. The ^{26}Al-activity ($t_{1/2}$ = 0.7 Ma) validates that age. The measured ^{10}Be is far too high compared to theoretical PRs (based on a C-content of 0.1%, as Canyon Diablo). This goes along with earlier studies [4, 5] demonstrating the big influence of inhomogeneously distributed traces as C, S, and P on the production of light nuclides.

Our second approach, using terrestrial ^{10}Be, leads to a minimum in situ exposure age of two quartz-rich samples from the crater wall of 200–250 ka. However, a larger age is very likely due to the subsequent erosion of the crater walls.

Preliminary paleomagnetic measurements of the granite within the crater revealed mixed normal and reverse magnetic field polarities suggesting a possible age for the impact remagnetization older than 780 ka.

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SIMS STUDY OF TUCSON (IRUNGR) SILICATES

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Introduction: Tucson is a unique polycrystalline ataxite with about 8 vol% silicates and a chemical composition of the metal (high Si: 0.8, Cr: 0.8 wt% and very low Ge, [1]) that make it distinctive among silicate-bearing iron meteorites [2–3].

Results: Silicate inclusions in the sections L3951 and Tucson B (NHM, Vienna) vary in size from ~40 to 1200 µm and are arranged in sub-parallel, curved plate aggregates ("flow pattern"). Inclusion sizes vary with the phases present. Small inclusions consist mostly of one (olivine) or two (olivine and glass) phases. Large ones are multiphase (e.g., olivine and pyroxenes as major phases, with minor glass, metal and brezinaite) and have serrated and/or smooth, curved interfaces with metal.

A typical large silicate inclusion consists of rounded olivines and irregular, cracked low-Al enstatite, all embedded in Al-rich low-Ca pyroxene. All phases are Fe-poor. Trace element contents of the Al-rich and Al-poor pyroxenes (arranged in decreasing order of Al_2O_3 content in the Fig.) are different. Variation among them is clearly observed over more than 1 order of magnitude in the abundances of the HREE (~0.05 to 1 × CI). In addition, low-Al pyroxene is poorer in Zr, Ti, Y, and Ca with respect to the high-Al pyroxenes. All phases (including olivine and glasses [4]) have a strong Nb- abundance anomaly, apparently caused by co-existing brezinaite, which has a very strong Nb+ anomaly The Al-rich pyroxene obviously is the latest phase that possibly formed by reaction of mainly olivine with a Si- and Al-rich medium. Consequently, the late addition of Al_2O_3 (and other refractory elements plus Si) to the early formed silicates must have been triggered by a (probably oxidative) destabilization of an early refractory element-rich phase. Like in other meteorites, silicates in Tucson also record highly reducing early and increasingly oxidizing conditions during their evolution—before they became trapped in the metal.

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