NICKEL ISOTOPES IN EUCRITES AND THE DISCORDANCE BETWEEN ISOTOPIC CHRONOLOGIES

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Introduction: The exact time-scale for eucrite genesis is still controversial: there is evidence that they formed 8 to 10 Myr after the start of the solar system ([1] and references therein) and evidence that reflects an earlier formation (e.g., [2]). The ^{60}Fe-^{60}Ni short-lived chronometer (half-life = 1.49 Myr) has the potential to provide powerful constraints on the age of the oldest basalts of our solar system. The first data were obtained on Chervony Kut and Juvinas using TIMS [3]. To broaden the set of data and obtain a more comprehensive picture of Ni isotopes in eucrites, we have been readdressing this topic using MC-ICPMS.

Leaching Experiments: Shukolyukov and Lugmair [3] have shown that Ni diffuses over a range of about 1 cm in the samples studied and that up to 80% of the total Ni present in a sample can be lost by acid washing. As it is a major concern directly related to the quality of the final data, we decided to make exhaustive tests of this. The leaching procedure is, indeed, critical for removing possible terrestrial contamination. First, we performed leaching experiments on a terrrestrial gabbro, as similar to eucrites as possible in terms of mineralogy, chemical composition, and Ni content. Leaching has been performed using several different media and for different time periods between 1 and 30 min. Short leaching (up to 5 min) generally has no effect on the isotopic and concentration results, while Ni isotopic compositions and concentrations are affected by longer leaching, indicating that artifacts are being introduced to the MC-ICPMS measurements. Dilute HCl has the weakest influence among the different solutions tested.

Results and Discussion for Eucrites: We started our investigation with the analysis of Juvinas and Bouvante, two non cumulate eucrites. Juvinas belongs to the main group of eucrites, while Bouvante is of particular interest because it is on the Stannern trend and presents the highest ^{182}W excess found up to now in eucrites. In a first stage, we analyzed several bulk rock samples for each meteorite because eucrites are known to be heterogeneous [3]. All samples are characterized by ^{60}Ni excesses, in good agreement with earlier results, but we find more radiogenic compositions for Juvinas than previously reported [3]. Ni excesses correlate with the Fe/Ni ratio of the samples and define pseudo "internal isochrons" even if these lines are not mineral isochrons. The ^{60}Fe/^{56}Fe ratios deduced from the slopes of the isochrons are between 10^{-9} and 8×10^{-8}. Assuming an initial ^{60}Fe/^{56}Fe between 1.2×10^{-6} [4] and 1.6×10^{-6} [5] for the solar system, the eucrites data define apparent ages of 6 to 16 Myr after the start of the solar system.

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THE COLÔNIA CRATER, A PROBABLE IMPACT STRUCTURE IN SOUTHEASTERN BRAZIL

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About 35 km from São Paulo, near Colônia, there is a conspicuous ring feature, 3.64 km in diameter, centered at 23°52′S, 46°42′20″W, within Precambrian crystalline basement rocks and defined by a hilly circular outer rim up to 125 m higher than an inner alluvial plain presently occupied by a swamp. The crater is filled with organic-rich clayey sediments of Quaternary age. A seismic survey indicated a maximum depth of 450 m to the Precambrian crystalline substratum within the crater [1], in accordance with magneto-telluric data [2] and inferences based on morphological parameters [3, 4]. A zone with low seismic velocity at the top of the basement may suggest the presence of brecciated and/or fractured rocks [1]. Paleogene sediments are tectonically imbricated within Precambrian gneisses of the basement in a low-angle fault zone 1 km southward from the structure, and this situation could represent a part of the overturned rim. The presence of higher altitudes in the southwestern part of the rim suggests a body trajectory from the northeast before the presumable shock.

The hypothesis that this feature is a probable impact structure has long been postulated, ever since the first studies carried out in the area [5]. Further studies based on morphological parameters [3, 4] and geophysical data [1, 2] have reinforced this idea. Alternative hypotheses to the origin of the Colônia crater, such as sinkhole, structural interference pattern, intrusion, and phreatomagmatic structure related to a kimberlite, among others, may be rejected, respectively, by the absence of carbonate rocks in the region, the persistence of the east-northeast structural trend of the basement, the lack of structures and/or minor intrusive bodies (dikes, sills) that should be associated with such intrusions, and the excessively unusually large dimension for a kimberlite pipe. Despite the above arguments, no direct evidence of an impact, such as shock metamorphism, has yet been observed in the area, most likely due to the intense weathering. The peculiar circular shape and the typical depth/diameter ratio [3], as well as the semi-circular outcrop patterns of the Paleogene sedimentary rocks along the southern and southeastern inner part of the rim, are the main indicators of a impact structure. The lack of convincing proof of endogenous process also reinforces this hypothesis.

At present, the Colônia crater is a probable impact structure with ejecta removed, rim partly preserved, although deeply eroded, and crater-fill products preserved. Based on palynological data [6, 7], the impact age is probably Neogene.

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