THE ^{81}Kr-Kr DATING TECHNIQUE FOR METEORITES

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Introduction: In solar system research one of the long standing questions is whether CAIs and/or chondrules are pre-exposed to galactic cosmic-rays relative to the rest of their host meteorites or not. This can only be answered using advanced dating techniques. We therefore check the ^{81}Kr-Kr dating technique (e.g., [1,3]) for meteorites. This technique is reliable and independent of the size of the meteorite, the shielding depth of the sample, and its chemical composition.

Methods and samples: We currently perform a systematic comparison of ^{81}Kr-Kr and ^{36}Ar-^{36}Cl ages for ordinary chondrites. We separated and cleaned metal samples of 13 chondrites: Alfianello (L6), Aumale (L6), Ausson (L5), Bruderheim (L6), Harleton (L6), Hessle (H5), Kanadahar (L6), La Criolla (L6), Mbale (L5/6), Mocs (L5/6), Mount Browne (H6), Peace River (L6), and St. Germain-du-Pinel (H6); all of them featuring long exposure ages and high metamorphic grades. After having measured ^{10}Be, ^{26}Al, and ^{36}Cl in the metal separates by AMS we currently measure ^{3,4}He, ^{21,22}Ne, and ^{36,38}Ar in aliquots of those samples by noble gas mass spectrometry. Based on the thus obtained data we determine reliable cosmic-ray exposure ages using the ^{36}Cl-^{36}Ar method. Bulk samples of the selected objects have already been analyzed for ^{3,4}He, ^{21,22}Ne, and ^{36,38}Ar. The data enable us to experimentally check model calculations of cosmogenic nuclide production rates [2] as well as to study diffusion losses of ^{3}H and/or ^{3}He in metal and silicate phases. Additionally, we calculated cosmic-ray exposure ages for all 13 objects using either the correlations given by [4] and [5] or using production rates based on state-of-the art modeling [2].

The study is currently be completed by the analysis of Kr and Xe isotopes, with a special emphasis on cosmogenic ^{81}Kr. In addition, we currently perform first model calculations for cosmogenic production rates of Kr and Xe isotopes. This study will not only improve our understanding of the ^{81}Kr-Kr-dating technique for meteorites, it will also significantly increase our knowledge about the cosmogenic production of heavy noble gases, their occurrence in refractory inclusions, and their role in the formation processes of meteorites and their components. Furthermore, exposure age studies of, e.g., CAIs, chondrules, rims around chondrules, dark and light inclusions, using the improved ^{81}Kr-Kr system will follow and will improve our understanding of timings and processes in the early solar system.

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