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Isotopic Composition of Presolar Spinel Grain OC2: Constraining Intermediate-Mass Asymptotic Giant Branch Models

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Presolar spinel (MgAl2O4) grains have been recently discovered in meteorites and represent the most abundant type of presolar oxides. The O, Mg and Al isotopic compositions of the vast majority of presolar oxide grains indicate that these grains originated in red giant and asymptotic giant branch (AGB) stars of masses lower than approximately 3 solar masses. Grain OC2 has a unique composition, showing most extreme O and Mg isotopic ratios among presolar oxide grains: O17/O16 three times higher than solar, O18/O16 26 times lower than solar, and excesses in Mg25 and Mg26 of (43+/-1)% and (117+/-1)%, respectively, with respect to solar. Its origin has thus been tentatively attributed to an AGB star of intermediate mass, around 5 solar masses. In intermediate-mass AGB stars the heavy Mg isotopes are produced in the He intershell by alpha-capture reactions on Ne22, while the O and Al compositions are mostly determined by proton captures at the base of the convective envelope (hot bottom burning). Using detailed models of AGB stars of different masses and metallicities that include Vassiliadis & Wood mass-loss rates and time-dependent convective mixing during the nucleosynthesis postprocessing, we analyse the O, Mg and Al compositions in AGB stars and discuss them in the light of the extremely precise measurements of the composition of grain OC2.

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