Magnesium isotopic systematics of the Makran arc, Iran: Implications for a hidden high-δ^{26}Mg reservoir in the continental crust

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Heavy Mg isotopes relative to the mantle are features found in many island and continental arc magmas and are generally explained by assimilation of preexisting crustal rocks or fluid-rock interaction in the subarc mantle. During chemical weathering, preferential leaching of Mg from the continents is able to fractionate Mg isotopes, generating isotopically light runoff and heavy weathering residues. The eroded residues might form siliciclastic sediments, be converted to metamorphic rocks, and be partially incorporated into magmas when the crustal column is distilled by arc magmatism. Alternatively, some altered MORB and abyssal peridotites have Mg isotopes heavier than the mantle and, when subducted, might become sources of fluid with high Mg content and heavy Mg isotopes that are able to metasomatize the subarc mantle. To better constrain the relative roles of metasediment and fluid in generating heavy Mg isotopic signature, we measure the Mg isotopic compositions of magmatic rocks from the Iranian segment of the Makran arc. The measured isotopic ratios, expressed as δ^{26}Mg, range from −0.32 to +0.32 ‰, which correlate negatively with MgO. This trend indicates that, with increasing degrees of differentiation, the magma becomes more susceptible to assimilation of high-δ^{26}Mg rocks, the protoliths of which are arguably the residue of chemical weathering. No systematic trends exist between Mg and Sr or Nd isotopes, indicating that the signature of low-temperature alteration has nothing to do with the age of preexisting crust. Our observations require the Makran arc magmas to be mixtures of juvenile mantle and preexisting crustal source rocks, and some of the latter represent a hidden high-δ^{26}Mg reservoir. This reservoir probably remains hidden in the continental crust because of deposition on continental shelves of carbonates, which are processed together with siliciclastic sediments through the weathering cycle.