Separation of the light rare earth elements for Ce and Nd isotope analysis

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The applications of ^{138}La-^{138}Ce (half-life 1.02×10^{11}years), ^{147}Sm-^{143}Nd (half-life 1.07×10^{11}years) and ^{146}Sm-^{142}Nd (half-life 6.8×10^{9}years) decay systems to unravel the time of geological processes and the interaction of geological reservoirs on earth are limited by the separation of the light rare earth elements (REE) and Ba. Cation resin is commonly utilized to preconcentrate the REE from the matrix of geological samples. The following separations of the multi-isotopic REEs from each other are achieved by cation resin coupled with a pH precisely adjusted α-*hydroxyisobutyric* (α-HIBA) solution or by organophosphorus Ln resins (e.g. *bis*-(2-*ethylhexyl*) phosphoric acid (HDEHP), 2-*ethylhexyl* (2-*ethylhexyl*) phosphonic acid (HEH[EHP]), and *bis*-(2,4,4 *trimethylpentyl*) phosphinic acid (H[DTMPeP])) with mineral acid (dilute HCl or HNO_3). The affinity of the REE with cation resin in HIBA solution decrease with atomic mass, hence, the heavy REE elements are eluted firstly. However, the elution sequence is opposite in Ln resin, where La is eluted earlier due to the lower partitioning coefficient of light REE with the Ln resins. The separation difficulties of the element pairs increase for Ba/La, Nd/Sm, La/Ce and Ce/Nd. Hence, if a certain chromatographic column could separate tervalent Ce from Nd, the isobars challenges of ^{138}Ba-^{138}La-^{138}Ce and ^{142}Ce-^{142}Nd could overcome. In the previous studies, $KBrO_3$ or $NaBrO_3$ are employed to oxidize Ce^{3+} to Ce^{4+}, while the other REE remain in the trivalent state, then Ce is separated from Nd by Ln resin. But the yield of Ce varies among the samples with different matrix, and the bromates are hard to purify, which may introduce additional background. Traditional α-HIBA method is strictly pH-dependent and light REE are eluted in the end, which is time-consuming. In contrast to the traditional column chromatography techniques, the high-performance liquid chromatography (HPLC) systems are not limited to the length or the diameter of the column, and could precisely control the elution volume. The HPLC system coupled with the organophosphorus resins is a rapid, stable, and accurate method to achieve excellent separations of Ce-Pr-Nd for the analysis of Ce and Nd isotopes.