Chemical and Isotopic (Sr, Nd) Analysis of the Nurra Basin Bentonites (NW Sardinia, Italy)

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The Nurra bentonite basin, located in northwestern Sardinia, represents one of the most significant bentonite mining districts in Europe. Among its deposits, the S'Aliderru site stands out for its production, exceeding 300,000 tons/year of material. The bentonite mineralization in this basin is genetically linked to the alteration of calc-alkaline pyroclastic rocks of Oligo-Miocene age. This study investigates the magmatic provenance and alteration processes responsible for bentonite formation by analyzing samples from the two main deposits, S'Aliderru and Sa Pigada Bianca, and from the Mandra Ebbas exploration permit area. A total of 30 samples, including tuffs and associated bentonites, were characterized through geochemical analysis of major and trace elements, as well as Sr-Nd isotopic analysis. The geochemical data reveal a systematic depletion in SiO_2, K_2O, and Na_2O, coupled with an enrichment in Al_2O_3, MgO, and Fe_2O_3, consistent with argillic alteration. Trace element patterns are enriched in Ba (with the highest variability), Li and V, and are depleted in Sr and Rb. Isotopic compositions show $^{87}Sr/^{86}Sr$ values ranging from 0.706752 to 0.710448, and $^{143}Nd/^{144}Nd$ values ranging from 0.512279 to 0.512492. Geochemical and isotopic variations are observed at both deposit and basin scales. The poorly variable Nd isotopic signatures are coherent with the Oligo-Miocene volcanic rocks of the region. Furthermore, the broader variability in Sr isotopic ratios implies the involvement of multiple alteration processes, potentially including interaction with seawater and/or hydrothermal fluids. Interestingly, the highest quality facies have extremely high $^{87}Sr/^{86}Sr$ values. These findings underscore the geochemical complexity of the Nurra basin and point to the need for further multidisciplinary investigations to construct a comprehensive genetic model at the basin scale.