Determination of production rates of cosmogenic nuclides based on data from large landslides in the Alps

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We are analyzing samples from boulder and bedrock surfaces associated with large prehistoric landslides in the Alps for ^{10}Be, ^{26}Al and ^{36}Cl. In addition to determining the ages for undated landslides, we are examining cosmogenic nuclide production rates based on results from landslides with independent age constraints (for example Flims, Graubuenden Switzerland and Koefels, Tirol, Austria). We focus on ^{10}Be, ^{26}Al in crystalline regions with abundant quartz, while ^{36}Cl is used in areas underlain by calcareous rocks. Potential complications include pre-exposure, post-slide rock fall, and shielding by soil or snow. Results from several sites as well as the problems encountered will be discussed.

Independent component analysis of isotopic compositions of oceanic basalts

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Isotopic variations in oceanic basalts indicate possible interactions among several distinct mantle components, such as DMM, EM, FOZO, C, HIMU, etc. Increasing number of data for various isotopic systems now allows us to systematically search the structure hidden in the multivariate compositional space by independent component analysis, ICA [1]. Principal component analysis (PCA) has been regarded to be the most efficient way to display the extreme mixing end-components. However, it has a fundamental problem: PCs are independent only when the data distribution follows the Gaussian distribution, which is not in this case. ICA is the method to deconvolute a data set into independent components that maximize the non-Gaussianity of the projected distribution of the data. Based on ICA, we have explored the isotopic compositional space of the oceanic basalts from Atlantic and South Indian Oceans, based on the data from literature [21] and GEOROC database. We show that the two independent compositional vectors/directions (referred to as independent components or ICs) are involved to create the variations with six isotopic ratios of Pb, Sr, Nd and Hf. One of the two ICs clearly divides OIBs and MORBs, while another IC distinguishes the geographical distribution including DUPAL anomaly. This feature supports that the two ICs are indeed independent. We also show that the conventional mantle end-components are not appropriate to represent the compositional space. Instead, two independent processes that create vectors parallel to DMM-FOZO or towards EM are proposed to explain the independent compositional space. Since the average composition of the oceanic basalts is similar to that of the average DMM, around which MORBs and OIBs are roughly symmetrically distributed in the IC space, we argue that these processes occur as two dominant but independent differentiation processes within the depleted mantle domain. Considering these nature, one IC is likely to be produced by recycling and stirring of MORB and its residue, while another IC is possibly created by the subduction zone processes. According to the ICs, the criterion of DUPAL anomaly is re-defined. As a result, distribution of the enriched region is modified, showing that the enriched signature disperses into the northern hemisphere.

References

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