

Trace element and Nd-Sr isotope systematics of phonolite and other rocks of the Chico Sill Complex, Northeast New Mexico

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Alkaline igneous rocks of Chico Sill Complex in northeastern New Mexico fall on the trend of the Jemez Lineament, an alignment of igneous centers that obliquely crosses the Rio Grande Rift. These 37 – 20 Ma intrusive rocks are spatially associated with younger rocks of the Raton-Clayton volcanic field, but clearly sample a different source. The sills were emplaced prior to rift extension. A subset of the spectrum of intrusive rocks (including phonolite, phonotephrite, trachyte, and lamprophyre dike rocks) is included in this study.

Phonolite is the most common rock type in the southeastern half of the sill complex and is the product of extreme fractional crystallization of a more mafic parent, but may not have evolved from the other lithologies studied. Trace element ratios and normalized-element plots suggest that at least two distinct differentiation trends produced phonolite, titanite fractionation played a role in differentiation, and a subduction component is absent from the phonolite source but may have contributed to other rock compositions. One odd feature is the enrichment of Zr as compared to other continental alkaline rock suites, in one phonolite trend relative to the other.

The subset of rocks studied shows initial Sr and Nd isotope ratios that are close to bulk-earth values, with epsilon Nd in the narrow range of 2.1 to -1.5 ($^{143}\text{Nd}/^{144}\text{Nd}$ between 0.51275 and 0.51256), and initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratios in the slightly broader, but still clustered range of 0.7042 to 0.7053. These isotope ranges are similar to many ocean-island basalts. The trail of the data toward higher $^{87}\text{Sr}/^{86}\text{Sr}$ values suggests a probable mixing curve with granitic or sedimentary rocks of the upper crust, although the degree of contamination must have been small and the contaminant is poorly defined.

Tracing global fallout using ^{210}Pb and artificial radionuclides inventories in mountainous area

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Inventories of unsupported ^{210}Pb in soils is used here as a tracer to estimate the effect of parameters such altitude, mean annual rainfall, vegetation on the long term input of atmospheric pollutants over mountainous area. Thus we examine exhaustively the magnitude and extent of soil inventories of unsupported ^{210}Pb in French mountainous areas. In addition, we combine artificial radionuclides from global fallout (mainly ^{137}Cs and Plutonium) with ^{210}Pb to compare deposition mechanisms of artificial and anthropogenic radionuclides. With this view, soils were sampled between 2000 and 2006 along transects of increasing altitude and subsequently increasing annual precipitation rate, in different mountainous areas.

Data shows that ^{210}Pb soil inventories are coarsely proportionnal to the mean annual precipitation occurring on each massif. Additionnaly in high-altitude sites, higher ^{210}Pb inventories than expected are explained by orographic effects. At last, climatic parameters, such as the intensity of rain episodes in Mediterranean regions probably induce specific deposition processes of ^{210}Pb explaining the relationship observed between soil inventories and rainfall. In addition to altitude and rain amount, the vegetation accounts for the intensity and the extent of ^{210}Pb deposition, since the excess ^{210}Pb in woodland soils reaches 30% with respect to grassland. Although the inventory of ^{137}Cs and plutonium from atmospheric nuclear weapons in soil also increases with mean annual rainfall, a significant decrease of $^{137}\text{Cs}/^{210}\text{Pb}$ ratios is observed in studied massifs from lowland to highland sites. This shows that at least two main tropospheric reservoirs with distinct $^{137}\text{Cs}/^{210}\text{Pb}$ ratios contribute to the mountainous soil inventory of atmospheric pollutants.