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SIGNIFICANCE OF THE Sm-Nd ISOTOPIC SYSTEMATICS OF THE AKILIA

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Samarium – Neodymium

Sm-Nd isotopic analyses were carried out on fourteen samples of basic to ultrabasic metavolcanics from several enclaves of the Amîtsoq gneisses (T ≈ 3,700 Ma). Field observations suggest that all the analyzed rocks belong to the pre-Amîtsoq Akilia Association. Consequently, a minimum age of 3,700 Ma is postulated for the emplacement of their protoliths.

When all the data points are put together in a conventional isochron diagram, no clear isochron relationship can be discerned. However, they seem to fall within a band broadly corresponding to an age of 3,600 Ma (Fig. 1).

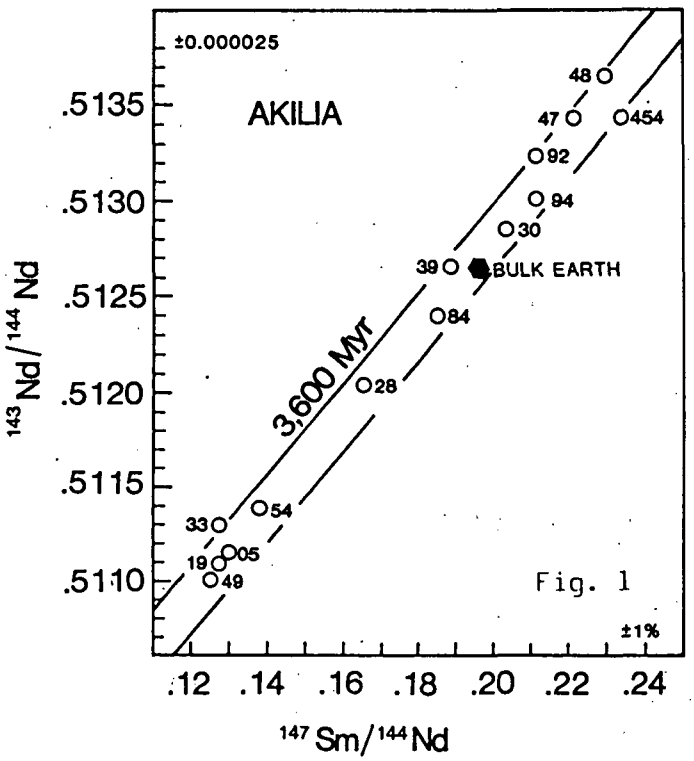


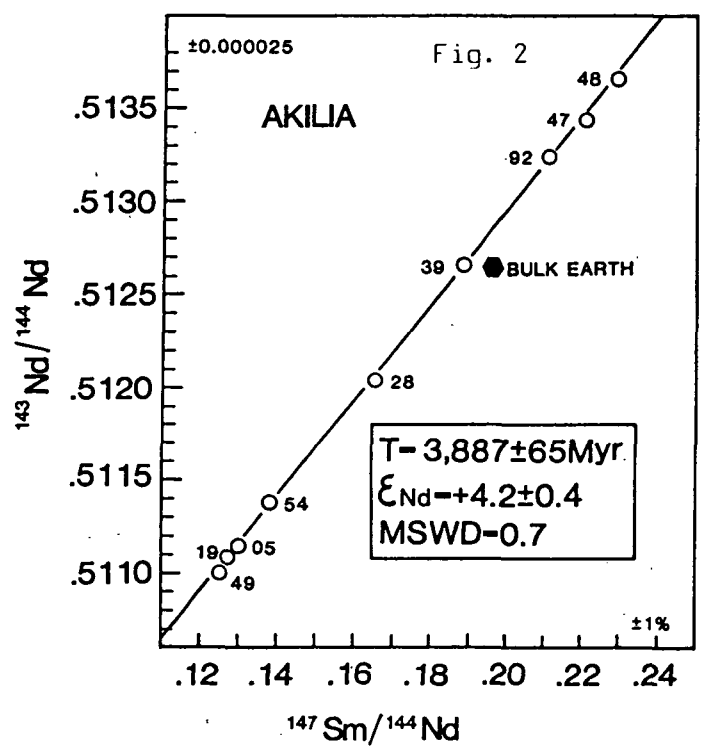
Fig. 1

The isotopic results are difficult to interpret satisfactorily. We offer in the following two contrasting interpretations : (1) data scatter as a result of open system behavior ; (2) data scatter due to a melange of data sets defining tow distinct isochrons.

(1) Open System Interpretation : Disturbance of Sm-Nd systems in high grade metamorphic terrains has been documented (1,2). The basic-ultrabasic enclaves of the Akilia Association have undergone very complicated metamorphic history (3,4,5). At least two prograde (3,600 Ma, 2,800 Ma)

and one retrograde (2,550 Ma) metamorphic episodes have been recognized (6, 7). The 3,600 Ma metamorphism has clearly affected the area from where the present samples were collected. Although it is not certain that the Sm-Nd systems of the studied samples have been opened, isotopic disturbance in these repeatedly metamorphosed enclaves is likely. Furthermore, because the data array seems to be parallel to the reference isochron of 3,600 Ma, it appears that the hypothesized open system might be concurrent with the 3,600 Ma granulite facies metamorphism (7). Accordingly, the scattering of data points (Fig. 1) could be due to incomplete rehomogenization of Nd isotopes during the granulite facies metamorphism. Alternatively, the scattering might represent additional disturbances during later metamorphic episodes.

(2) Two-Isochron Interpretation : Assuming no post-magmatic isotopic disturbances have occurred, the present data sets could be resolved into two well-defined isochrons : (1) $T = 3,887 \simeq 65$ Ma, $\varepsilon_{Nd}(T) = + 4.2 \pm 0.4$, (Fig. 2) ; (2) $T = 3,112 \pm 154$ Ma, $\varepsilon_{Nd}(T) = + 1.0 \pm 0.9$, (Fig. 3). In other words, the scattering of data points shown in Fig. 1 was a result of mixed populations representing a set of Akilia rocks and a set of post-Amîtsoq Malene metavolcanics respectively.



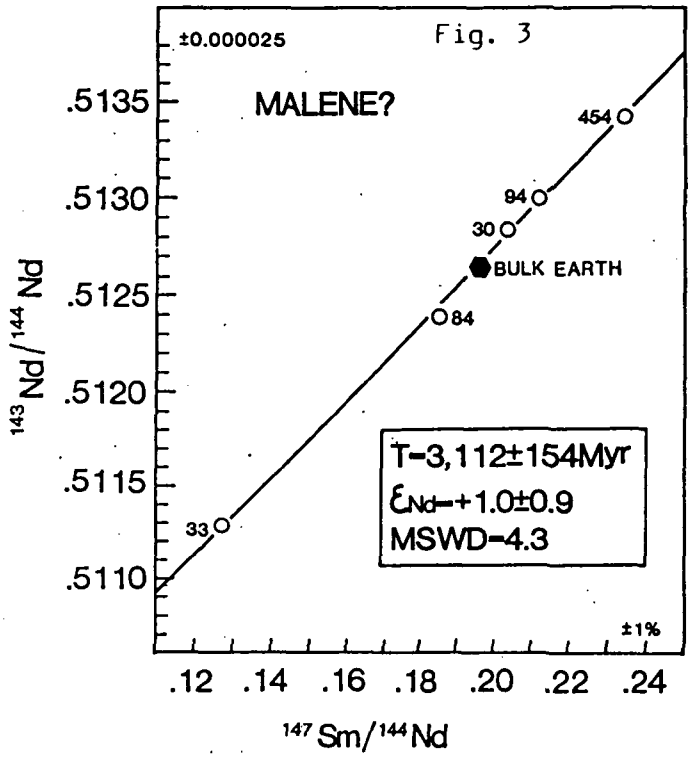


Fig. 3

The grouping in Figs. 2 and 3 was made by visual judgement and is certainly subject to debate. Two sets of arguments could, however, support this interpretation. First, the Akilia association and the younger Malene Supracrustals are known to have very similar lithologies (3,8). Both have been severely deformed and folded during later tectono-metamorphic episodes, and are now intimately juxtaposed (9). Recognition of the two supracrustal sequences in such highly deformed areas may not be easy. Hence it is possible that samples of different sequences have been collected and analyzed. Second, the two "isochron" ages correspond reasonably, may it be accidently, to the anticipated events for the volcanisms of the Akilia Association ($T \geq 3,800$ Ma) and the Malene Supracrustals ($T \approx 3,100$ Ma, 4).

At present, we have no preference over the two alternative interpretations. Should the second interpretation be proven correct, both the age (3,887 ± 65 Ma) and the high positive ε_{Nd} value (+ 4) would be very significant in the understanding of the early chemical evolution of the terrestrial mantle. High positive ε_{Nd} values (+ 2 to + 3.5) have also been reported for several units of the Isua Belt ($T \approx 3,800$ Ma, 10). All these data suggest that at least some parts of early mantle have been highly depleted and isolated soon following the accretion and very early differentiation of the Earth about 4,500 Ma ago.

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