Nd AND Sr ISOTOPIC ANALYSES OF METALLIC IRON-BEARING VOLCANICS FROM DISKO ISLAND, GREENLAND.

*C.A. Goodrich and **P.J. Patchett, *Lunar and Planetary Laboratory, **Department of Geosciences, University of Arizona, Tucson AZ, 85721.

Introduction: We have analyzed Sr and Nd isotopes in eight samples from the 55 m.y. metallic iron-bearing volcanics of Disko Island, Greenland, which are part of the West Greenland-Baffin Island basalt province. These rocks are the product of contamination of mantle-derived picritic to tholeiitic magmas by Cretaceous to early Tertiary sediments through which they erupted [1,2,3]. Assimilation of carbon from the sediments led to reduction of the magmas and formation of metallic iron-carbon alloys [3,4,5]. Two samples of carbonaceous shale, which was probably the major contaminant, were also analyzed. The purposes of this study were: 1) to examine the diversity among the mantle and sedimentary precursors to the iron-bearing volcanics, and to determine the Sr and Nd isotopic characteristics of those end-members; 2) to help us develop special techniques in preparation for the main focus of our investigation, an isotopic study of ureilites [6], in particular to develop a procedure for dissolution of graphite in order to determine whether graphite could contain significant REE.

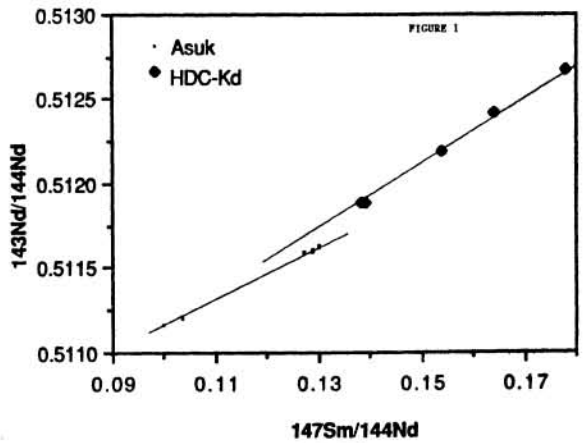
Samples: As8097, As80102, and As80120 are metallic iron-bearing andesites from the composite iron-bearing flow at Asuk, which is part of a minor contaminated system within the Naujánguit Member of the Vaigat Formation [1,7,8]. They represent the earliest contaminated rocks of the West Greenland basalt province. These samples contain carbon-rich buchites, derived from shale inclusions [9]. As804 and As808 are shales from Asuk, representing the Cretaceous sediments that directly underlie the iron-bearing flow at Asuk [7]. HC80295, HC80251, HC80266 and HC801 are from the Hammers Dal Complex (HDC), a subvolcanic intrusive complex that was a feeder for iron-bearing lavas of the Niaquassat Member of the Maligât Formation [10]. Kd112 is from the iron-bearing basaltic dike at Kitdlit [11,12,13], which resembles dikes of the HDC, and may also have been a feeder for Niaqussat Member flows. Except for HC80251, which is from the chill zone of the HDC, these samples all contain plagioclase-graphite-spinel xenoliths [14], derived from carbonaceous shale inclusions.

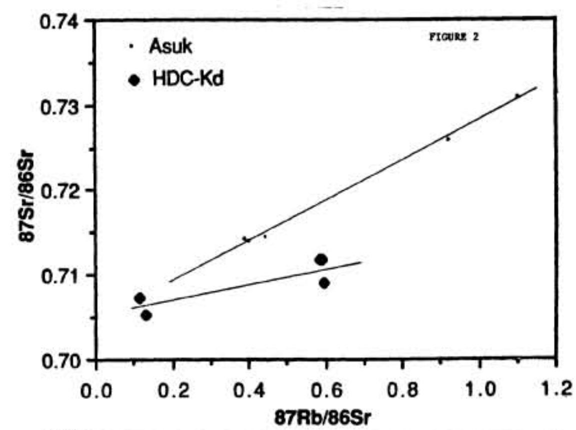
Analytical Techniques: Analytical procedures for the Disko samples followed those described by [15]. Levels of background contamination were approximately those cited by [15]: 500pg Sr, 30pg Sm, and 80pg Nd. These levels were subsequently reduced to 5pg Sm and 35pg Nd for analysis of ureilites. Recovery levels for Sr and Nd were ~50% and 60-70%, respectively. Separation procedures were subsequently altered to raise these levels to ~90% for ureilite work. Graphite is not dissolved by the standard dissolution procedure described by [15] because conditions are never sufficiently oxidizing. The graphite residue from As80120 was washed in HCl to remove adhering sample solution and placed in 12M $HClO_4$ in a sealed PTFE pressure vessel. After 19 days at 150°C, the graphite was completely dissolved. The solution was then spiked, chemically separated, and analyzed.

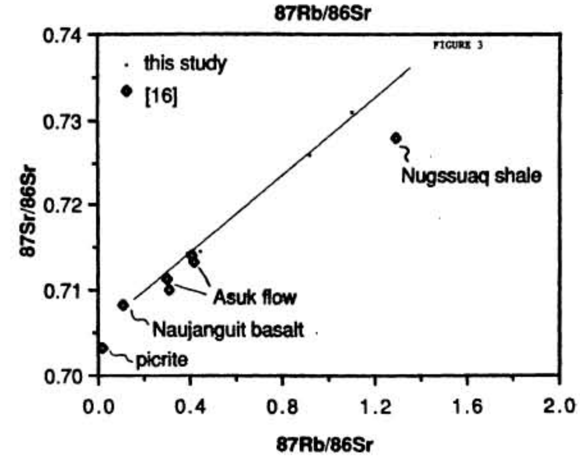
Results: The ten samples define two mixing trends (Fig. 1) on a plot of $^{143}Nd/^{144}Nd$ vs. $^{147}Sm/^{144}Nd$ (2σ errors in $^{143}Nd/^{144}Nd$ are 0.008 -0.014 per mil and are indicated by the size of the symbols for the Asuk samples). The andesites and sediments from Asuk form one mixing line; the HDC and Kitdlit dike samples form another, which passes near the Asuk sediments. These results indicate that distinct parental magmas are required for the Vaigat Formation and the Maligât Formation, but that the sediments with which each were contaminated were similar with respect to Nd isotopes and Sm/Nd. Picrites or magnesian basalts from the Naujánguit Member of the Vaigat Formation are likely candidates for parental magmas of the Asuk trend. A.K. Pedersen has kindly supplied us with several such samples, which we plan to analyze. Primitive, uncontaminated rocks from the Niaquassat Member that might be candidates for the parental magma of the HDC trend are unknown (A.K.Pedersen, pers. comm.). HC80251, from the chill zone of the HDC, appears to be the least contaminated sample we have. Our data suggest that the HDC parental magma was more evolved than the Asuk parental magma, which is consistent with the observation that feldsparphyric tholeiites dominate the upper Members of the Maligât Formation.

The Sr isotopic data (Fig. 2) also show two mixing trends (2σ errors in $^{87}Sr/^{86}Sr$ are 0.008-0.014 per mil and are indicated by the size of the symbols for the Asuk samples). The Asuk trend is well-defined, and consistent with data of [16] for the Asuk flow. Their analyses of the andesitic part of the flow are identical to ours, and their analyses of the basaltic part of the flow plot on or near our trend (Fig. 3). An olivine porphyritic basalt from the Naujánguit Member [16] also plots near this trend (Fig. 3) and appears to be a good candidate for the parental magma. Picrites from the Naujánguit Member [16], which are similar to the uncontaminated Baffin Island tholeiites [17], are more primitive than the parental magma required for the Asuk trend (Fig. 3). This parental magma was proabably slightly contaminated by crustal material itself. The composite Nugssuaq shale, used by [16] in model mixing calculations, does not plot along the trend (Fig. 3). Apparently there was considerable heterogeneity in the Sr isotopic composition of the West Greenland shales. The HDC trend (Fig. 2) is less well-defined, but points to a parental magma similar to that of the Asuk trend. Data from [16] for various contaminated rocks of the Niaqussat Member are consistent with this trend, and show the same degree of scatter. However, this trend points to a contaminant with a more primitive Sr isotopic composition than the shales. This contaminant might have been sedimentary material that had previously been infiltrated by basaltic magmas. This is consistent with the upper stratigraphic position of the Maligât Formation, and with compositions and thermal histories inferred for the plagioclase-graphite-spinel xenoliths from the HDC and Kitdlit dike. This hypothesis will be tested by analyzing a suite of xenoliths separated from the HDC and Kitdlit dike.

The results of the graphite analysis showed that at most 1 per mil of the Nd in As80120 was contained in graphite and was therefore not accessible to the standard dissolution procedure. We cannot say whether this Nd was contained structurally within the graphite, or was contained in silicate inclusions trapped inside graphite. We will also perform this experiment on the graphite residues from ureilites [6].







References: [1] A.K. Pedersen (1985) *Bull. GGU* **152,** 126 pp. [2] A.K. Pedersen (1978) *Bull. Geol. Soc. Denmark, Spec. Iss.* **27,** 117-130. [3] A.K. Pedersen (1975) *Rapp. GU* **75,** 48-51. [4]C.A. Goodrich and J.M. Bird (1985) *J. Geol.* **93,** 474-492. [5] H. Pauly (1969) *Meddr. dansk geol. Foren.* **19,** 8-26. [6] C.A. Goodrich *et al. This volume.* [7] A.K. Pedersen (1973) *Rapp. GGU* **53,** 21-27. [8] A.K. Pedersen (1985) *Rapp. GGU* **124,** 30pp. [9] A.K. Pedersen (1979) *Contrib. Mineral. Petrol.* **69,** 83-94. [10] F. Ulff-Moller (1977) *Rapp. GGU* **81,** 15-33. [11] A.K. Pedersen and F. Ulff-Møller (1980) *Rapp. GGU* **100,** 51-55. [12] A.K. Pedersen (1970) *Contrib. Mineral. Petrol.* **69,** 397-407. [13] F. Ulff-Møller (1979) *Rapp. GGU* **95,** 30-34. [14] W.G. Melson and G. Switzer (1966) *Am. Miner.* **51,** 664-676. [15] P.J. Patchett and J. Ruiz (1987) *Contrib. Mineral. Petrol.* **96,** 523-528. [16] A.K. Pedersen and S. Pedersen. *In press.* [17] R.K. O'Nions and D.B. Clarke (1972) *EPSL* **15,** 436-446.

Supported by NASA grant NAG 9-39 (to M.J. Drake) and NSF grant EAR 8615844 (to P.J. Patchett).