

MELTING OF MAFIC AND FELSIC SOURCES TO PRODUCE THE HREE-DEPLETED DACITES OF THE MICHIPICOTEN GREENSTONE BELT, ONTARIO: P.J. Sylvester, Code SN4, NASA/Johnson Space Center, Houston, TX 77058, K. Attoh, Dept. of Geology, Hope College, Holland, MI 49423, and K.J. Schulz, U.S. Geological Survey, Reston, VA 22092

HREE-depleted dacites and tonalites comprise a significant component of the Earth's Archean sialic crust. They are widely believed to have formed by 10-30% melting of mafic source rocks in the lower crust [1, 2], and thus reflect a simple transformation of simatic to sialic material during the Archean. We have shown previously on the basis of trace element data [3] that the HREE-depleted dacites of the Michipicoten greenstone belt, Ontario may be derived anatectically from granulite facies mafic gneiss of the Kapuskasing structural zone. (The Michipicoten belt and Kapuskasing zone are interpreted to be upper and lower levels, respectively, of an uplifted oblique section of Archean crust [4].) This model requires, however, that significant amounts of biotite and orthopyroxene remain in the residue after about 9% melting, and that tonalitic veinlets in the gneiss form as restite following melting of an andesitic component in the largely mafic parental material. Field and petrographic examination of the Kapuskasing gneisses [5, 6] suggests that only trace amounts of biotite and orthopyroxene are typically present in the mafic residue, the tonalitic veinlets probably comprise a felsic melt fraction derived via anatexis of a mafic parent, and both mafic gneiss and felsic paragneiss underwent melting. We have thus re-evaluated the origin of the Michipicoten HREE-depleted dacites by taking these observations into account.

Using mathematical expressions for trace element behavior during equilibrium batch partial melting [7], average mineral modes of tonalite veinlet-free, biotite- and orthopyroxene-poor, portions of the Kapuskasing gneisses (calculated by mass balance of Kapuskasing mineral [5] and whole rock [6] compositions), a range of published mineral-liquid partition coefficients (see references in [3]) and assumed trace element starting compositions for typical Archean basalt and greywacke [2], the concentrations of the REE, Hf, Th, Sc, Co, Cr, Rb, Sr and Ba in felsic partial melts in equilibrium with Kapuskasing mafic gneiss and paragneiss have been calculated. REE compositions of felsic melts derived from Kapuskasing mafic gneiss are most similar to Michipicoten HREE-depleted dacites after about 10% melting of a depleted Archean tholeiite starting composition or approximately 50% melting of an enriched tholeiite composition, whether relatively low (D_1) or high (D_2) partition coefficients are used (figs. 1 and 2). However, the slope and abundance of the modelled LREE concentrations are fit poorly to the observed data. The 10% model melt of depleted tholeiite and 50% model melt of enriched tholeiite also do not exhibit Th, Co and Ba abundances that are similar to the HREE-depleted dacites (figs. 3 and 4).

More successful models for the petrogenesis of the dacites are obtained if felsic partial melts in equilibrium with Kapuskasing paragneiss (assuming an Archean greywacke starting composition) are mixed with the melts derived from the mafic gneiss. For example, a mixture of a 25% melt of greywacke and a 10% melt of depleted tholeiite or a mixture of a 65% melt of greywacke and a 50% melt of enriched tholeiite possess trace element abundances (including the LREE, Th, Co and Ba) similar to the HREE-depleted dacites (figs. 3, 4 and 5).

The trace element data are therefore consistent with the field and

petrographic evidence for anatexis of both Kapuskasing mafic gneiss and paragneiss to produce the HREE-depleted dacites of the Michipicoten belt. Based on at least this case, models for growth rates of sialic crust during the Archean should not assume a simple sima to sial transformation, since significant re-working of existing sialic crust probably also is involved.

References. [1] Arth, J.G. and Hanson, G.N. (1975) *Geochim. Cosmochim. Acta*, v. 39, p. 325-362. [2] Condie, K.C. (1981) *Archean Greenstone Belts*, Elsevier, Amsterdam, 438pp. [3] Sylvester, P.J., Attoh, K. and Schulz, K.J. (1985) *Lunar and Planetary Science XVI*, p. 835-836. [4] Percival, J.A. and Card, K.D. (1983) *Geology*, v. 11, p. 323-326. [5] Percival, J.A. (1983) *Am. Mineral.*, v. 68, p. 667-686. [6] Percival, J.A., personal communication. [7] Hanson, G.N. (1980) *Ann. Rev. Earth Planet. Sci.*, v. 8, p. 371-406.

