JURASSIC BIMODAL MAGMATISM IN NE PALMER LAND, ANTARCTIC PENINSULA: GEOCHEMISTRY AND TECTONIC SETTING.

H.E. Wever & B.C. Storey.

British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge CB3 OET, UK.

Résumé

On rapporte les premières recherches d'une association bimodal de basaltes tholéiitiques et des roches acides de la Péninsule Antarctique qui, pendant les temps Mésozoïque, était continue avec les Andes de l'Amérique du Sud. Des résultats géochimiques suggèrent que ces roches se sont formées dans un basin marginal situé en arrière d'un arc actif continental.

Key words: tholeiite, back-arc basin, ensialic, crustal melt.

During Jurassic-Cretaceous times extensional marginal basins and contemporaneous silicic to bimodal volcanism were common along the continental margin of South America. The extent to which these phenomena occur along the once contiguous proto-Pacific margin of Antarctica has not clearly been established. There are few constraints on the petrogenesis of the silicic volcanic rocks of southern South America, but they are generally attributed to widespread crustal anatexis during intra-continental extension associated with the fragmentation of Gondwanaland. There is even more uncertainty about the tectonic setting of the extended marginal basins, in particular to what extent their formation is related to contemporaneous subduction along the Pacific plate margin.

In this study we present new geochemical and isotopic data of a Jurassic bimodal association of tholeiitic greenstones and silicic metavolcanic rocks from the Antarctic Peninsula, which have some bearing on these problems. The Antarctic Peninsula represents an "Andean" magmatic arc system, juxtaposed between the Pacific Ocean and the Weddell Sea, and is dominated by calc-alkaline magmatic rocks related to active subduction during most of the Mesozoic. The prominent bimodal association occurs in an previously unmapped region in NE Palmer Land, situated along the inboard margin of the magmatic arc and the western edge of the Weddell Sea.

The mafic greenstones are divided into three main sub-groups, which are indistinct in the field but have geochemical characteristics of IAT (group I), E-MORB (group II), and transitional calc-alkaline-tholeiites (group III). Groups I and II have a similar range in ϵ^{150}_{Nd} (between -1.2 and 3.7), which suggests they may have been produced from a similar slightly heterogenous source. The rocks of group III are derived from a slightly higher ϵ^{150}_{Nd} mantle source ($\approx$ 5.5).

Trace element concentrations of the silicic metavolcanic rocks show a distinct "within-plate" affinity. These rocks are peraluminous and have variable but low ϵ^{150}_{Nd} (between -2.2 and -8.4) in comparison with the greenstones. This indicates that they contain a significant proportion of crustal material and have not been fractionated from the mafic greenstones.

The isotopic and geochemical characteristics of the greenstones of group I and group III are uncommon for active Andean plate margins with a thick continental crust. Their close temporal and spatial association with E-MORB (group II), which have similar LILE-enrichment (Th/Ta ratios 2.2-3.5), suggests that the greenstones formed in a supra-subduction zone setting and were emplaced in a back-arc basin. This basin was broadly contemporaneous with the formation of the Andean rocas verdes. However, in a recent geochemical study on the "rocas verdes" from South Georgia Storey & Alabaster (this volume) propose that these rocks formed in a Gulf of California type setting, hence the back-arc basin in NE Palmer Land cannot be regarded as a southwards extension of the "rocas verdes" basin.

The silicic metavolcanic rocks from NE Palmer Land are contemporaneous with the break-up of Gondwanaland and may to some extent be related to a similar cause. They are not derived from the associated tholeiitic greenstones, they have "whithin-plate" affinity, and formed by extensive remobilization of crustal basement. This is consistent with their formation in an ensialic back-arc basin where, during early stages of continental lithospheric attenuation, the ascent of mafic mantle derived magma may have caused widespread crustal melting.

In conclusion, we suggest that the bimodal association in NE Palmer Land was produced in an extensional marginal basin located behind an active continental arc system, i.e. a classic ensialic back-arc basin. By anology, some of the silicic to bimodal volcanism along the Pacific-plate margin of South America may have formed in a similar way, which implies that this type of magmatism may be more common for Andean orogenesis than previously recognised.