Mississippian ocean island basalts from the Western palaeo-Pacific Ocean in the Cache Creek Terrane of British Columbia

A.D. Smith

Department of Earth Sciences National Cheng Kung University, Tainan, Taiwan, R.O.C.

The Cache Creek terrane of British Columbia ontains Mississippian alkali basalts of ocean island origin. Tethyan faunas indicate the terrane traversed the entire width of the Paleo-Pacific Ocean. Coincidence of the Nd-Pb isotopic signatures of the islands and the continental mantle of east Asia suggests an origin from Gondwanan thermal boundary layer mantle delaminated into the asthenosphere during the Devonian separation of South China.

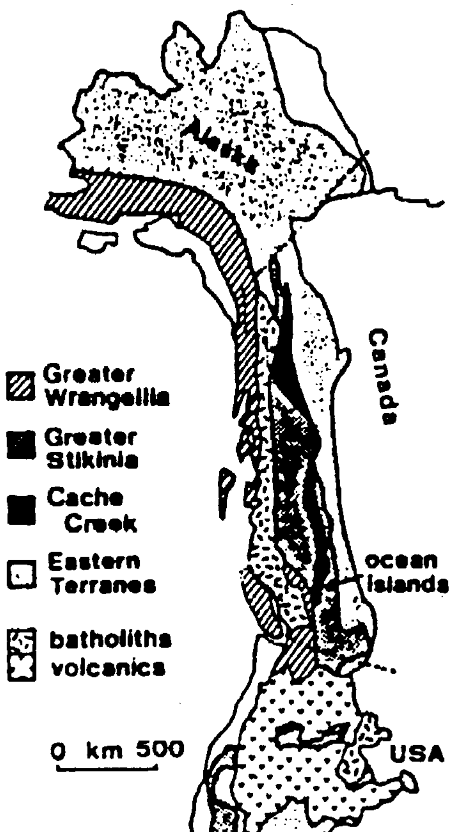

FIG. 1. Location of the Cache Creek terrane in the North American Cordillera.

Introduction

The Cache Creek terrane of the North American Cordillera comprises a subduction melange of limestone and basalt (Monger 1977). Separating accreted terranes which originated marginal to the continent (Eastern Assemblage and Greater Stikinia from fragments of Gondwana in the Greater Wrangellia composite terrane (Fig. 1), it is the only Cordilleran remnant of a basin the entire width of the Paleo-Pacific Ocean. The strata represent a series of ocean islands and fringing reefs which collided with North America in the Late Triassic (Monger 1977). Tethyan faunas indicate an equatorial western Pacific position from the Mississippian to Permian, with the implication that the origin of the islands is related to events along the eastern margin of Gondwana.

Geochemistry

Lower greenschist to blueschist facies volcanic rocks from the Bonaparte subterrane (Fig. 1 comprise a suite of mildly alkaline basalts and picrites with 44.5 to 48.5 wt.% SiO_2, to 20 wt.% MgO, and 80 to 600 ppm Ni. Trace element ratios such as Zr/Y = 5.5 to 8.5, Ce/Nb = 1.4 to 1.8 are typical of ocean island basalts (OIB). Parallel incompatible trace element profiles (Fig. 2a) suggest the compositional range is an effect of olivine accumulation rather than partial melting. However, the decrease in abundance with increasing element incompatibility relative to average OIB (Fig. 2b) does suggest higher degrees of partial melting than for most OIB.

Faunal evidence indicates a Lower to Upper Mississippian age such that the isotopic compositions in Fig. 3 have been corrected to 330 Ma. This yields εNd = +4.0 to +7.8, and initial $^{206}Pb/^{204}Pb$ = 18.16 to 20.76, $^{207}Pb/^{204}Pb$ = 15.54 to 15.74 correcting for an assumed μ value of 15.

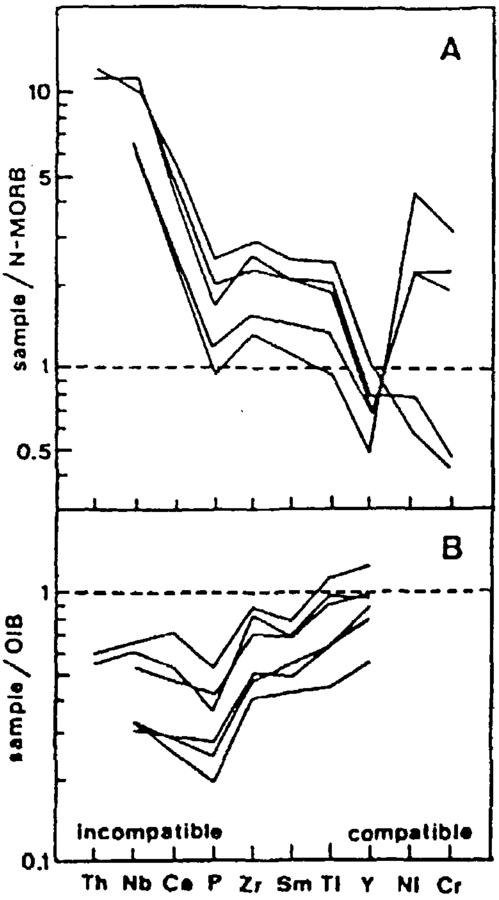

FIG. 2. Trace element compositions of Cache Creek basalts normalised to (a) average N- MORB and (b) average OIB.

EM1 and a DM-HIMU mixture are identified as the source components (Fig. 3).

Tectonic Model

Generation of the Cache Creek islands followed rifting of the South China composite terrane and the basement to Greater Wrangellia (Gehrels and Saleeby 1987, Coney 1990) from the eastern margin of Gondwana in the Early to Middle Devonian. In Fig. 3, the EM1 signature may be equated with Gondwanan continental mantle. Such material could be mobilised into the

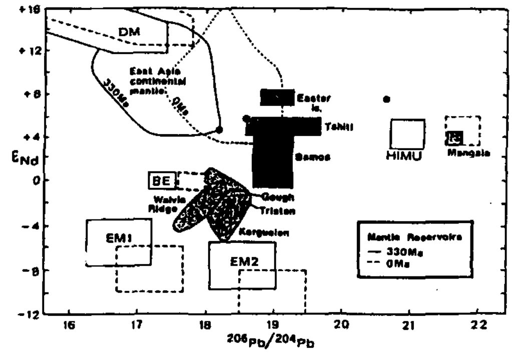

FIG. 3. Nd-Pb isotopic variation in Cache Creek basalts (•) relative to the mantle components of Zindler and Hart (1986) and S.E. Asia continental mantle (Tatsumoto et al. 1992). Age corrections for mantle reservoirs have been calculated assuming μ values of 8.4, 8.0, 15, 8.15, 8.ñ and Sm/Nd values of 0.325, 0.35, 0.33, 0.22, 0.2 for BE, DM, HIMU, EM1, EM2, respectively. Compositions of modern ocean islands are illustrated for comparison.

asthenosphere by rifting of the continent under a hotcell regime (Smith 1993). The delaminated material along with surrounding heterogeneities (DM-HIMU) in the asthenosphere would then melt, producing the volcanism after the major rifting event. The onset of migration of the Cache Creek terrane and Greater Wrangellia across the Paleo-Pacific coincides with a later, Permian rifting event which displaced terranes across Tethys to form southeast Asia.

References

Coney, P.J. (1990) In *Terrane Analalysis of China and the Pacific Rim* (Wiley, T.J., Howell, D.G., and Wong, F.-L., eds.) Earth Science Series, v.13, 49–69, Circum Pacific Council for Energy and Mineral Resources.

Gehrels, G.E., and Saleeby J.B. (1987) *Tectonics*, **6**, 151–73.

Monger, J.W.H. (1977) *Can. J. Earth Sci.*, **14**, 1832–59.

Smith, A.D. (1993) *Terra Nova*, **5**, 452–60.

Tatsumoto, M., Basu, A.R., Huang, W.-K., Wang, J.-W., and Xie, G.-G. (1992) *Earth Planet. Sci. Lett.*, **113**, 107–28.

Zindler, A., and Hart, S.R. (1986) *Ann. Rev. Earth. Planet. Sci.*, **14**, 493–571.