

## The earliest Jurassic circum-Atlantic large igneous province: new evidence for a brief, extremely widespread event

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The Central Atlantic Province (CAP) is an Early Jurassic large igneous magmatic province associated with the early stages of break-up of Pangea and preceding the opening of the Central Atlantic ocean. Previous geochronological (e.g. Dunning and Hodych, 1990; Sebai *et al.*, 1991; Deckart *et al.*, 1997), geological and petrological (e.g. Bertrand, 1991; Holbrook and Kelemen, 1993) data show that widespread Early Jurassic magmatism occurred in W-Africa, eastern N-America and northern S-America (French-Guyana and Surinam). This magmatism (dykes, sills and lava flows) is represented by low TiO<sub>2</sub> (<2wt.%) basaltic tholeiites (LTB), characterized by low Nb (i.e. negative Nb spikes on multi-element patterns). Isotopic compositions are highly variable, suggesting involvement of heterogeneous lithosphere, mantle and crust, in the petrogenesis of CAP tholeiites.

Mesozoic magmatism is widespread also in northern and central Brazil (NCB), affecting Archaean-Early Proterozoic cratonic areas and Late Proterozoic-Phanerozoic basins. High TiO<sub>2</sub> Cretaceous tholeiites are confined to E-Brazil (mainly Paraná basin and Rio Grande do Norte), generally along the South Atlantic margin, while a broad belt, extending from Mato Grosso (central Brazil) to the Amazon and Paranaíba basins (N-Brazil), far inside the S-American platform, is characterized by LTB tholeiites. These LTB range generally in composition from tholeiitic basalts to andesi-basalts. The NCB LTB tholeiites have relatively variable trace element and isotopic compositions. For example, little evolved (MgO>5.5 wt.%) LTB from the Maranhão basin have REE patterns ranging from N-MORB to E-MORB like, and Sr-Nd isotopic compositions

ranging from 0.70302 to 0.70748 and from 0.51248 to 0.51293, respectively. Similar compositional differences characterize tholeiitic dike swarms of Roraima and sills of Cassiporé, and lava flows of the Amazonian basins and of the Anari and Tapirapuã formations. No clear systematic compositional difference are noted between the different regions. In general, the LTB tholeiites of NCB are similar to the previously studied Early Jurassic tholeiites of W-Africa and eastern N-America.

<sup>40</sup>Ar/<sup>39</sup>Ar geochronological analyses have been carried out on 15 samples of feldspar separated from LTB dykes and lava flows of NCB (Anari-Tapirapuã, Roraima, Cassiporé, Amazônia, Maranhão). Detailed (up to 80 steps) incremental heating yields well defined plateaux (Fig. 1) and isochrons which range from 190.5 ± 0.8 to 203.3 ± 0.9 Ma (1 s analytical precision), and show a peak at 199 Ma. These ages are coincident with previous <sup>40</sup>Ar/<sup>39</sup>Ar data from occurrences farther north (e.g. Sebai *et al.*, 1991; Deckart *et al.*, 1997), if the same age (28.02 Ma) of the Fish Canyon sanidine neutron fluence monitor is considered. Considering systematic errors in decay constants and the ages of standards, the well-defined 199 Ma peak in <sup>40</sup>Ar/<sup>39</sup>Ar data coincides with the 201 Ma U/Pb ages determined for eastern N-America sills (Dunning and Hodych, 1990).

The geochronological and geochemical data require extension of the CAP to a much larger portion of S-America than has previously been recognized, suggesting Early Jurassic magmatism preceding the opening of the Central Atlantic affected a total area of ca. 6000 Km (N-S) by ca. 3000 Km (E-W). Thus the CAP may well be the largest continental igneous province in terms of aerial extent.

Despite its huge extension, CAP magmatism

occurred in a short time. Considering the new  $^{40}\text{Ar}/^{39}\text{Ar}$  and previous  $^{40}\text{Ar}/^{39}\text{Ar}$  and U/Pb geochronological data, CAP magmatism lasted probably only a few My, and defined a peak at 199 Ma (mean age =  $198.8 \pm 0.9$  Ma). This peak of the magmatic CAP activity falls close to the currently proposed, but not well defined, age of the Triassic-Jurassic boundary (e.g.  $205.7 \pm 4$  Ma: Gradstein *et al.*, 1994), suggesting a possible influence of CAP magmatism on mass extinction events occurring at this time.

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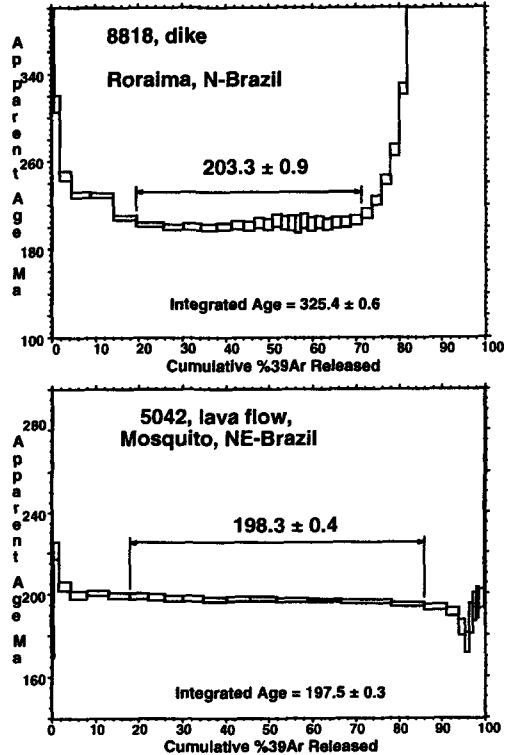


FIG. 1. Representative  $^{40}\text{Ar}/^{39}\text{Ar}$  age spectra of analysed dyke and lava flow samples of NCB. Age of 28.02 Ma is considered for Fish Canyon Sanidine (FCs) neutron fluence monitor.