

CARBONATITES FROM SOUTHEASTERN BRAZIL: Sr-Nd-Pb SYSTEMATICS

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Early and Late Cretaceous carbonatitic complexes from southern Brazil occur along the main tectonic lineaments of the South America platform. A similar situation is recognized for the Angolan and Namibian occurrences in Africa.

Processes of liquid immiscibility are believed to have generated carbonatitic liquids, as evidenced by the field relationships and by the geochemical characteristics.

Calcio-, magnesio- and ferrocarnatites are widespread even in the same complex (Fig. 1). The remarkable scatter of the incompatible elements is mainly due to (1) the control of accessory phases, e.g. apatite, pyrochlore, fluorcarbonates and fluorite, and (2) the repeated overprinting of hydrothermal over magmatic processes.

Sr-Nd-Pb systematics highlight heterogeneous mixtures between HIMU and EMI mantle components, likewise to the associate alkaline rocks and the flood tholeiites of the Paraná-Angola-Namibia Province (Fig. 2).

The areal distribution shows that the time-integrated isotopic enrichment of the carbonatites and alkaline rocks decreases from West (Eastern Paraguay) to East (Angola and Namibia), and it is associated with the age decrease of the alkaline magmatism, i.e. from Early Cretaceous to Tertiary.

As a whole, the data indicate that the alkaline-carbonatitic magmatism originated from a significant but small scale heterogeneous subcontinental mantle. In this scenario, the Walvis Ridge-Rio Grande Rise and Vitória-Trindade hotspot tracks might reflect the accommodation of stresses in the lithosphere during rifting, rather than continuous magmatic activity induced by mantle plumes beneath the moving lithosphere (Fig. 3).

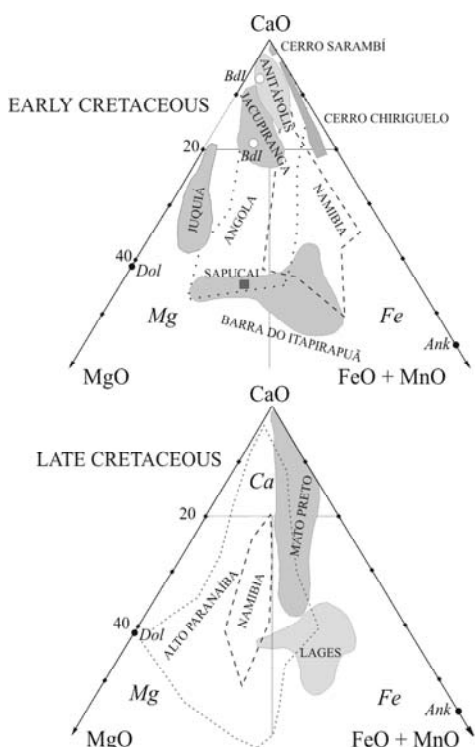


Figure 1. Classification of the carbonatitic associations (after Woolley & Kempe, 1989) in the various complexes and fields from southern Brazil, Angola and Namibia. Data source, Brazil: Morbidelli et al. (1986), Censi et al. (1989), Beccaluva et al. (1992), Meyer et al. (1994), Huang et al. (1995), Toyoda et al. (1995), Ruberti et al. (2002), Comin-Chiaramonti et al. (2001a, 2002) and unpublished data; Angola: Alberti et al. (1999) and therein references; Namibia: Milner & Le Roex (1996), Le Roex & Lanyon (1998), Kurszlaukis et al. (1999).

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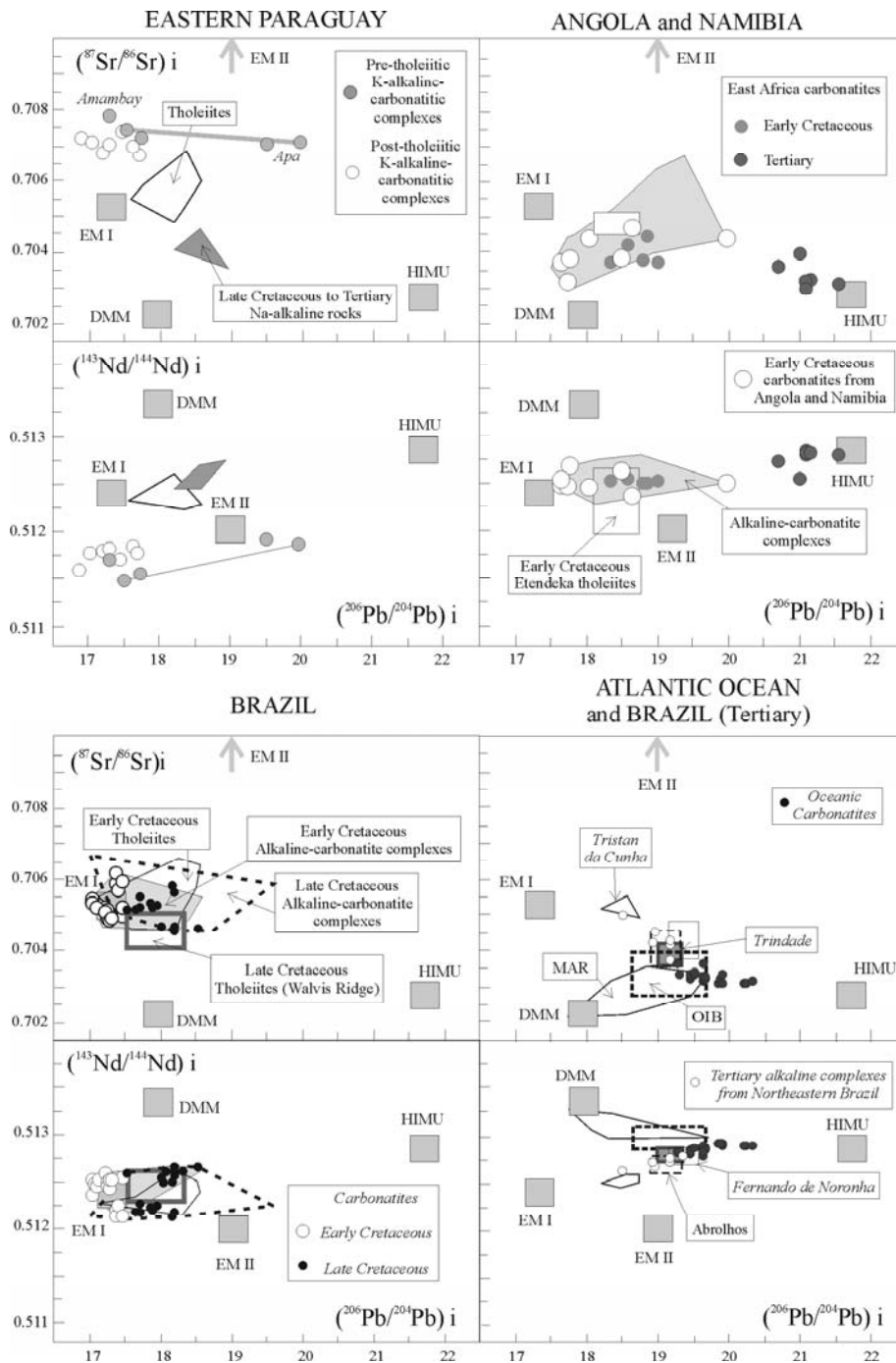


Figure 2. Sr_i and Nd_i vs. $^{206}\text{Pb}/^{204}\text{Pb}$ (initial ratios). Data source, A, Eastern Paraguay: Comin-Chiaramonti et al. (1991, 1995, 1997, 2001b), Comin-Chiaramonti & Gomes (1996), Castorina et al. (1997), Marques et al. (1999a), Comin-Chiaramonti (unpublished data); B, Angola and Namibia: Milner & Le Roex (1996), Le Roex & Lanyon (1998), Gibson et al. (1999), Harris et al. (1999), Ewart et al. (1998), Cooper & Reid (1998), Smithies & Marsh, 1998, Alberti et al. (1999), Kurzslaukis et al. (1999); East Africa: Bell & Tilton (2001); C, Brazil, Early Cretaceous: Toyoda et al. (1995), Huang et al. (1995), Walter et al. (1995), Garda et al. (1995), Marques et al. (1999a), Gibson et al. (1999), Andrade et al. (1999), Comin-Chiaramonti et al. (2001a, 2002), Ruberti et al. (2002); Uruguay, Early Cretaceous: Kirkstein et al. (2000); Brazil, Late Cretaceous: Bellieni et al. (1990), Bizzi et al. (1994, 1995), Toyoda et al. (1994), Meyer et al. (1994), Gibson et al. (1995, 1997, 1999), Carlson et al. (1996), Thompson et al. (1998); D, Atlantic Ocean: Walvis Ridge, Richardson et al. (1982); Rio Grande Rise, Gamboa & Rabinowitz (1984); Mid Atlantic Ridge (MAR), Hamelin et al. (1984), Ito et al. (1987), Fontignie & Shilling (1997); OIB, Halliday et al. (1988, 1995); Atlantic carbonatites, Hoernle et al. (2002); Tristan da Cunha, Le Roex (1985), Le Roex et al. (1990); Trindade, Marques et al., (1999b), Siebel et al. (2000); Brazil, Tertiary: Serra do Mar, Thompson et al. (1998), Bennio et al. (2002); Abrolhos, Fodor et al. (1989); Northeastern Brazil, Fodor et al. (1998); Fernando de Noronha, Gerlach et al. (1987). DMM, HIMU, EMI and EMII are approximations of mantle end-members taken from Hart et al. (1992). It should be noted that in all the diagrams the Rio Grande Rise basalts (not shown) plot in the same field of the Walvis Ridge samples.

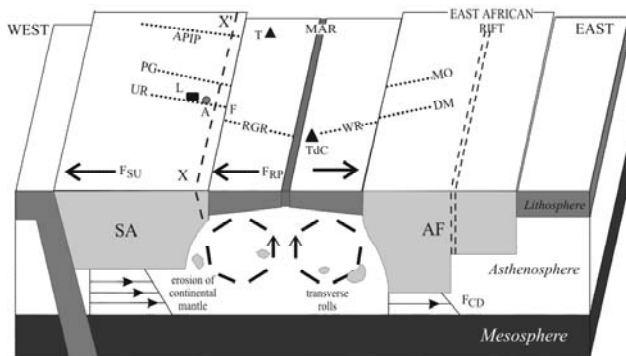


Figure 3. Forces acting on plates in rotational model illustrated for the South Atlantic Ocean (after Smith & Lewis, 1999, modified). Major rifting occurs parallel to X-X' pre-existing suture. Intraplate volcanism follows the second order sutures (e.g. PG-MO: Ponta Grossa-Moçâmedes Arch, UR: Uruguay lineament; DM: Damara belt). SA: South America plate; AF, African plate; RGR: Rio Grande Rise; WR: Walvis Ridge; TdC: Tristan da Cunha; T: Trindade. F_{CD} : continental drag; F_{RP} : ridge push; F_{SU} : trench suction. F, Florianópolis; A, Anitápolis; L, Lages.

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