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PROVENANCE OF DETRITAL CLAY MINERALS OF THE CONTINENTAL RIFT OF SOUTHEASTERN BRAZIL: MINERALOGICAL AND Sm-Nd DATA

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INTRODUCTION

Following the global changes occurred at the K/T boundary, the Paleogene was marked by worldwide paleogeographic reorganizations (Pomerol, 1982; Berggren et al., 1985). At this time, the opening of the South Atlantic Ocean was still in progress, resulting in the generation of several sedimentary basins along the Brazilian coast. The sedimentary rocks of the Continental Rift of Southeastern Brazil (CRSB) are the most complete record of the geological events developed in the onshore area during this period. The provenance of these sedimentary deposits was studied, with emphasis placed on the mineralogy of the clay minerals and recognition of their possible source areas based on Nd isotopic signatures of whole rock and clay (finer than 2 microns) fraction from the central segment of the CRSB.

GEOLOGICAL SETTING

The Continental Rift of Southeastern Brazil (CRSB) (Riccomini, 1989), of Cenozoic age, is an ENE-trending, elongate, narrow trough, about 1000 km long, that stretches from Curitiba (Paraná) in the WSW to Barra de São João (Rio de Janeiro) in the ENE (Fig. 1). The CRSB was formed as a result of late processes related to the break-up of Gondwana, separation of South America from Africa and the opening of the South Atlantic Ocean. In the early Tertiary, NNW-SSE regional extension, related to thermomechanical tilting of the adjoining offshore Santos basin, reactivated ENE shear zones within the Precambrian basement leading to the generation of continental half-grabens.

The sedimentary filling, syn-tectonic to the NNW-SSE extension, is mainly represented by Eocene-Oligocene alluvial siliciclastic rocks (conglomerates, sandstones and mudstones) deposited in an alluvial fan system. Oligocene lacustrine claystones and shales are interfingered with the alluvial sediments in the central portion of the CRSB.

MATERIALS AND METHODS

The studied samples were collected in several outcrops in the central segment of the CRSB (Taubaté and Resende basins) and in a core drilled in the central part of the Taubaté Basin (Fig. 1).

Mineralogical analyses, including petrographic studies, X-ray diffraction and scanning electron microscopy, were developed in the laboratories of the IGUSP. All Nd isotopic analyses were carried out in the Geochronology Laboratory of the UnB, after sample dissolution in the laboratories of the IGCE/UNESP.

MINERALOGICAL AND GEOCHEMICAL RESULTS

Mudstones and claystones in the CRSB are massive and made up essentially of detrital smectite and interstratified illite-smectite (I/S). Mica and kaolinite occur in variable proportions and quartz and feldspar are the main sand-grained clasts in these rocks. The smectite and I/S are platy and relatively coarse-grained (plates coarser than 5 microns in diameter), with slightly undulated boundaries (Sant'Anna, 1999).

T_{DM} model ages obtained for whole rock mudstones and claystones of the central segment of the CRSB vary between ca. 1.8 and 2.2 Ga (Table 1). These values indicate the Precambrian basement as the main source area, for which Proterozoic to Archean T_{DM} model ages were already recorded (e.g. Sato & Campos Neto, 1996; Tassinari & Sato, 1996; Cordani & Sato, 1999). The analyzed clay fraction of lacustrine claystone also displays Proterozoic model age (ca. 1.9 Ga). Younger model age of ca. 1.3 Ga was obtained only for whole rock of alluvial mudstone probably derived from mixed source areas, the Precambrian rocks and Late Cretaceous alkaline massifs (which have T_{DM} model ages around 0.8 Ga).

DISCUSSIONS AND CONCLUSIONS

At the end of the Late Cretaceous and beginning of the Paleogene the relief was low due to the development of the South American Planation Surface (King, 1956). In this geomorphologic context, the origin of the detrital smectite and I/S is attributed to chemical weathering processes forming paleosols by the alteration of the Precambrian basement rocks of CRSB probably during the Early Tertiary. Late Cretaceous alkaline massifs may have contributed only locally. The smectitic paleosols were transported into the continental half-grabens by mudflows in an alluvial fan system during the Eocene-Oligocene, passing laterally and upwards to lacustrine conditions, in the Oligocene (Riccomini et al., 1996; Sant'Anna, 1999).

Eocene sediments of the offshore basins, São Paulo Plateau and Rio Grande Rise are abundant in detrital smectite, considered as supplied from emerged South American continent (Robert, 1987). Geological, mineralogical and geochemical data obtained for the smectitic clay minerals of the CRSB indicate that landmasses in southeastern Brazil probably acted as a major source area to the detrital clay sedimentation in western South Atlantic during this time.

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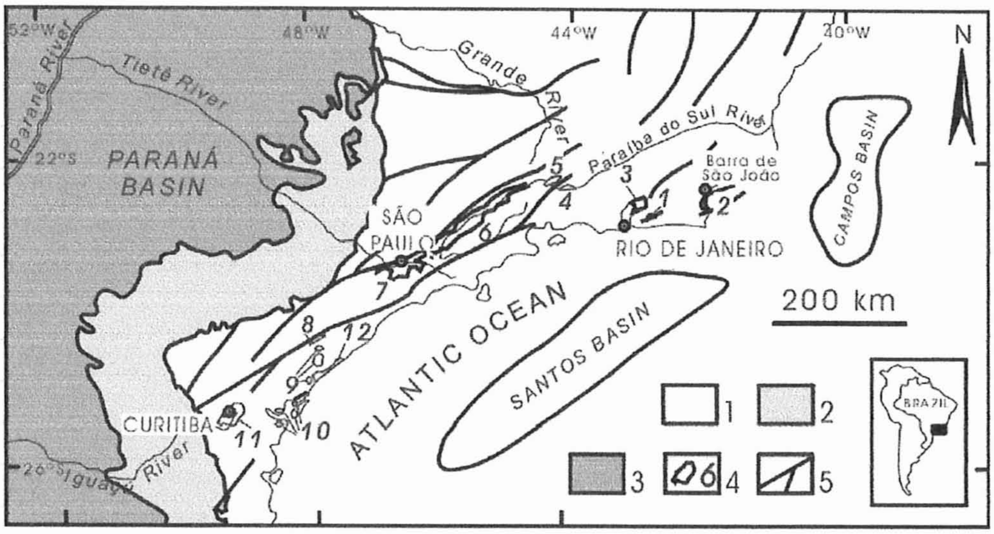

Figure 1. Regional context of the CRSB (Riccomini et al., 1996): 1) Precambrian basement; 2) Paleozoic and Mesozoic sedimentary deposits of Paraná basin; 3) Mesozoic flood basalts, Serra Geral Formation; 4) Tertiary basins and associated deposits of the CRSB (1- Itaboraí basin, 2- Barra de São João graben, 3- Macacu basin, 4- Volta Redonda basin, 5- Resende basin, 6- Taubaté basin, 7- São Paulo basin, 8- Sete Barras graben, 9- Pariqüera-Açú Formation, 10- Alexandra Formation, 11- Curitiba basin, 12- Guaraqueçaba graben); 5) Precambrian shear zones, partially reactivated in the Mesozoic and Cenozoic.

Table 1. Sm-Nd data of sedimentary rocks from the Taubaté and Resende basins.

Sample n°.	Basin	Sm(ppm)	Nd(ppm)	$^{147}Sm/^{144}Nd$	$^{143}Nd/^{144}Nd$ (± 2SE)	ε(o)	T_{DM} (Ga)
TB50C	Taubaté	11,11	57,89	0,1160	0,511800±32	-16,34	1924
CNP96	Taubaté	7,998	42,752	0,1131	0,511771±13	-16,91	1913
TB534RA	Taubaté	6,632	36,345	0,1103	0,11767±22	-16,99	1867
TB534RA (< 2μm)	Taubaté	6,724	37,043	0,1097	0,511738±10	-17,56	1900
QZ18	Taubaté	56,088	378,44	0,0896	0,511975±21	-12,93	1304
CNP 270	Taubaté	6,772	37,223	0,1100	0,511743±06	-17,46	1897
CNP 314	Taubaté	6,699	36,968	0,1095	0,511727±09	-17,77	1912
CNP 688	Taubaté	3,965	23,054	0,1040	0,511731±09	-17,69	1809
CNP 711	Taubaté	6,691	36,03	0,1123	0,511730±06	-17,71	1959
CNP 738	Taubaté	11,315	65,818	0,1039	0,511728±07	-17,74	1812
CNP 763	Taubaté	5,90	34,16	0,1044	0,511752±06	-17,28	1786
CNP 806	Taubaté	5,34	34,10	0,0946	0,511717±25	-17,96	1685
CNP 818	Taubaté	9,76	55,45	0,1064	0,511693±07	-18,44	1904
RE 10A	Resende	13,072	82,43	0,0959	0,512010±07	-12,26	1328
CNP 33	Taubaté	4,418	25,502	0,1047	0,511703±08	-18,23	1860
CNP 46	Taubaté	6,116	35,44	0,1043	0,511727±06	-17,77	1821
CNP 148	Taubaté	5,743	32,49	0,1068	0,511675±32	-18,78	1937
CNP 289	Taubaté	5,123	28,71	0,1079	0,511725±07	-17,81	1884
RE 14	Resende	5,508	32,85	0,1013	0,511536±06	-21,50	2032
RE 16	Resende	24,274	122,325	0,1200	0,511707±06	-18,16	2160