ACTAS

II SIMPOSIO SUDAMERICANO DE GEOLOGIA ISOTOPICA

II SOUTH AMERICAN SYMPOSIUM ON ISOTOPE GEOLOGY

Argentina 1999

SUBSECRETARÍA DE MINERÍA DE LA NACIÓN

ISSN 0328-2325

CORDOBA 1999

INSTITUTO DE GEOLOGÍA Y RECURSOS MINERALES

SEGEMAR

SERVICIO GEOLÓGICO MINERO ARGENTINO

ANALES XXXIV

THE MAGMATISM OF THE ITAJAÍ BASIN, SC – SOUTHERN BRAZIL, AND ITS IMPORTANCE TO DEFINE THE PROTEROZOIC-PHANEROZOIC LIMIT

Miguel A.S.Basei, Oswaldo Siga Jr., Umberto G. Cordani, Kei Sato and Patrícia S. de Lima

Universidade de São Paulo, Instituto de Geociências. Rua do Lago, 562, CEP-05508-900, SP, São Paulo, Brasil. baseimas@usp.br

Keywords: Itajaí basin, turbidites, Proterozoic, Cambriam, Chancelloria sp.

INTRODUCTION

The Itajaí Basin represents, together with Corupá, Campo Alegre and Guaratubinha (SC), Camarinha and Castro (PR) and Camaquã, Santa Bárbara and Piqueri (RS), the major basins developed in the transition period within the metamorphic-deformational climax of the Neoproterozoic fold belts and the installation, from the Ordovician, of the Paraná Sineclise.

In the Paraná and Santa Catarina States, as a function of their relation with the Neoproterozoic belts, these basins can be classified in two main groups: 1)-*Foreland basins* (Allen *et al*, 1986) in which the border near the fold belts is much more deformed than the opposite border. This is specially true in the Itajaí Basin, in which the northern border is in clear unconformity with the gneissic basement. The deformation in this basin is clearly related with NW-trending thrusts which place the Brusque Group metasediments above the sedimentary units of its south border. Similar relationship is seen for the Camarinha Formation and adjacent Ribeira belt. 2)-*Extensional-Late Collision Basins* (IF and LL types, Kingston et al, 1983), these basins do not present a direct relationship with the southern Brazilian fold belts, are not folded, and were affected only by rigid (brittle) tectonics. The Itajaí and Camarinha foreland basins have predominantly epiclastic arenaceous sediments deposited in a range of environments from delta fans to distal turbidites. Conglomerates and pelitic horizons form an important part, volcanic rocks are subsidiary and limestones are absent. The extensional late collisional basins of Campo Alegre, Guaratubinha, Corupá and Castro have an important intermediate to acid volcanic component (in many cases up to 90%), represented by lavas, pyroclastics and subordinate dykes.

ITAJAÍ BASIN

The Itajaí basin occupies an area of more than 700 km² in the northeastern part of Santa Catarina, near the Itajaí River valley. It is elongated along N60E and is characterized by a thick epiclastic sedimentary succession with subordinate trachytic to rhyolitic volcanics and pyroclastics. Pioneer studies of this basin divided the Itajaí series into the basal Ibirama Formation, of quartzites and phyillite horizons grading upwards into massive and laminated slates with small conglomerate lenses. The upper Gaspar Formation contains a thickening-upwards sequence beginning with psammo-pelitic slates and ending with the thick Baú conglomerates. Silva and Dias (1981) inverted this stratigraphy, placing the Gaspar formation, composed of psammitic sequences with minor conglomeratic and vulcanic rocks at the bottom. The pelitic and pelitic-psammitic rhythmites were grouped into the Campo Alegre formation, and there correlated with similar rocks in another basin further north; they were placed at the top of the basin sequence.

Basei (1985) and Basei *et al* (1987) attributed a thickness of 7500 meters to the Itajaí Group emphasizing the presence of turbidites in its constitution. They showed that it has been affected by two deformational phases also present in the fold belt formed by the Brusque Group, and interpreted the structure as a monoclinal with vergence towards the granulite terrane to the northest. They proposed that it is composed of two main units, divided into four informal lithostratigraphic sub-units: (i) the lower psammitic unit, equivalent to the Gaspar Formation, with an arenaceous-conglomeratic subunit containing thick arkosic sandstones intercalated with lenses of polymitic conglomerates and volcanic tuffs, overlain

by a rhythmic sandstone-silt subunit with microconglomeratic layers; and (ii) the upper silty unit, with a silty-arenaceous subunit with predominant silts at the base and a silty-pelitic unit of homogeneous clay-and siltstones, containg small lenses of coarser material at the top.

Appi and Cruz (1990) and Rostirolla (1991) elaborated a stratigraphic arrangement in systems of sedimentary tracts, identifying a lower sequence - the Gaspar Formation - formed by a low-level tract and a transgressive sequence represented by a condensed distal system of rhythmic slates which formed from an eroded upper tract. Citroni (1993) identified four main sedimentary facies associations, defined according to their depositional environment:1)-Turbitic associations (1.1 sandstone-conglomerate dense turbidites; 1.2 thick graded dense turbidites; 1.3 classic medium density turbidites; 1.4 attenuated turbidites); 2)-basin associations (2.1 hemipelitic; 2.2 subaqueous slides); 3)-transitional associations (3.1 coastal plain sandstones) and 4)-continental associations (4.1 ruditic alluvial fans; 4.2 intercalated alluvial sandstones).

Paim *et al.* (1997) characterized the presence of the *Chancelloria sp.* fossil within the silt-pelitic units of the center-southern portion of the basin. The existence of this fossil confirmed the marine environment suggested by the sedimentary associations. This fossil is considered as typical of the Lower to Middle Cambrian and, for this reason, the authors attributed a maximum age of sedimentation of 540 Ma for the Itajaí Group, complying with the new international proposal for the beginning of the Cambrian period.

THE MAGMATISM IN THE ITAJAÍ BASIN

The mark of the major acid magmatism that occurred in the Itajaí Basin can be documented along the whole depositional history of this basin. In the basal arenaceous-conglomeratic units, intercalations of 10 to 20 cm-thick layers of tuffs and volcanic ashes are frequent within metric arkosic sandstone banks. In the conglomeratic levels the presence of pebbles of volcanic rocks of varied sizes (from some millimeters to 20 cm) characterize a volcanism manifestation since the beginning of the basin development.

The main occurrence of the acid magmatism is in the form of rhyolitic domes with preferential distribution along the major axis of the basin. These rocks are either concordant with or intrusive in the sedimentary rocks. Next to these domes it is frequent the presence of volcanic breccias and rocks made exclusively of fragments of volcanic origin within the sedimentary matrix. Massive, pink to reddish, hololeucocratic, felsic volcanic and subvolcanic rocks predominate, showing porphyritic texture with potassic feldspar phenocrysts (occasionally plagioclase) in a matrix made of quartz, potassic feldspar and plagioclase. Subordinately biotite, chlorite, zircon and opaque minerals occur.

The Subida granite occurs in the southwestern end of the Itajaí Basin and is partially covered by the Permo-Carboniferous sediments of the Itararé Subgroup. It is a rosy (sometimes greenish), equigranular, medium- to coarse-grained, isotropic leucogranite, with phaneritic texture. It is constituted by perthitic potassic feldspar (50%), oligoclase (10%), microgranophyric quartz (30%), amphibole and/or biotite (maximum 10%) and phyllosilicate aggregates (5%, replacing amphibole). Zircon, apatite and fluorite are accessories. It is of alkaline affinity, being clearly intrusive in the Itajaí Group sediments. At the borders of the granitic body sediment xenoliths and a contact metamorphism rim can be observed.

GEOCHRONOLOGICAL STUDIES

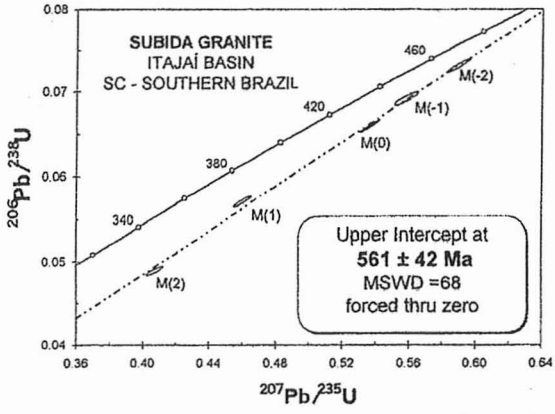

Fig 1- U-Pb data for zircons from Apiuna Rhyolite.

The previous geochronological results were mainly obtained by the Rb-Sr methodology in sedimentary (Macedo *et al.* 1984) and igneous rocks (Basei *et al.* 1987). These values suggest a time interval of *ca.* 40 Ma between the age of sedimentation (580 Ma) and the emplacement of the acid bodies represented by the Apiúna volcanics and the Subida granite, around 545 Ma. The basin deformation would be associated with the Brusque Group nappes which, with the NNW transport, overthrust its southern border and introduce

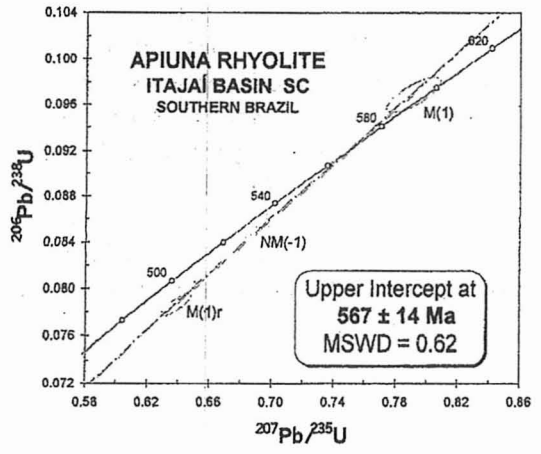

Fig 2 - U-Pb Concordia Diagram for Subida Granite

a deformation throughout the sedimentary strata. This deformation, which develops a plane-axial schistosity with sericite and biotite in the pelitic levels, was dated at 534±4 Ma (Basei *et al.* 1992) with Rb-Sr isochrons for volcanic tuffs deformed during the folding process.

The new U-Pb analysis of zircon concentrates from Apiúna volcanic rocks indicate an age of 567 ± 14 Ma (Fig 1). SHRIMP analyses obtained in zircons extracted from the same volcanic rock, confirmed the previous value, providing an age of 563 ± 14Ma (U.G.Cordani, pers. communication). A minimum age for the deposition of Itajaí sediments was also provided by a U-Pb zircon age of 561 ± 42 Ma, obtained for the intrusive Subida granite. These ages, older than the previous Rb-Sr isochrons, are here considered to be probably closer to the real age of the acid magmatism.

CONCLUSIONS

The radiometric ages obtained for the magmatism observed in the Itajaí Basin, despite the large individual error of the analyses, suggest, as a function of their producibility, that the Itajaí Group sedimentation would have occurred before 560 Ma ago. However, it is possible, considering the close relationship between magmatism and sedimentation, that the deposition of great part of the sediments of this basin's medium to upper portion happened close to this age.

The values obtained for the Itajaí Basin magmatism are *ca.* 30 Ma younger than the available ages for the Campo Alegre and Guaratubinha basins (Basei *et al.* in press), showing an important diachronism between these basins, considered as being of a transition period.

The Itajaí basin was affected by the terminal stages of the evolution of the adjacent fold belt, and this deformation is placed in the Cambrian at 534 ± 4. As a response to compressive regimes there are no expressive magmatism nor sediments of Cambrian age known in the basement terranes of Paraná and Santa Catarina States. Only at the begin of the Ordovician, did this part of southern Brazil change its tectonic regime to receive the important sedimentary sequences of the Paraná Intracratonic Basin.

Considering that the fossil found in the Itajaí Basin is a Cambrian taxon and that the data here presented suggest that the younger age possible for the Itajaí sedimentation is 560 Ma, it is here stressed the impossibility to accept 540 Ma as the oldest age possible for the beginning of the Cambrian and therefore of the Proterozoic-Phanerozoic limit. The old limit of 570 Ma seems to be the best applicable in the case in question.

REFERENCES

Allen, P.A., Homewood,P. and Willians, G. D.,1986. Foreland Basins: an introduction. Spec. Publs. Inst. Ass. Sediment, 8: 3-12.

Appi, C.J., Souza Cruz, C.E., 1990. Estratigrafia de seqüências na Bacia do Itajaí. In: Braz. Congr. of Geology, 36, Natal, 1990. Anais, Natal, SBG, Vol.1, pages 93-106.

Basei, M.A.S.,1985. O Cinturão Dom Feliciano em Santa Catarina. Unplublished PhD thesys presented to the Institute of Geosciences, USP. 191 p.

Basei, M.A.S., Citroni, S.B. and Siga Jr., O., 1999. Stratigraphy and Age of Fini-Proterozoic Basins of Paraná and Santa Catarina States, Southern Brazil, Boletin Série Científica , Inst. de Geociências –USP (in press).

Basei, M.A.S., Kawashita, K. and Siga JR., O. 1987. Idade,características litoestratigráficas e estruturais do Grupo Itajaí, SC. In: South Brazilian Congress of Geology,3,Curitiba, PR. 11: 93-106.

Basei, M.A.S., Siga Jr., O.S. and Machiavelli, A.,1992. A tectônica de Nappes do Proterozoico Superior e Eopaleozoico da porção sul brasileira. In: Aceñolaza, F.G. & Esteban, S.B. (eds.): El Paleozoico Inferior en Latinoamerica y la genesis del Gondwana. Serie Correlación Geológica. 9: 215-217

Citroni, S.B., 1993. Ambientes deposicionais e significado geotectônico da sedimentação do grupo

Itajaí. SC. Mastership Dissertation presented to The Institute of Geosciences, USP, 145 p. (Unpublished).
Kingston, D.A., Dishroom,C.P. and Williams, P. A., 1983. A. A. P. G. Bull., 67: 2173-2193.
Macedo, M.H.F., Basei, M.A.S., Bonhomme, M.G. and Kawashita, K., 1984. Dados Geocronológicos referentes às rochas metassedimentares do Grupo Itajaí (SC). Revista Brasileira de Geociências. 14(1): 30-34.
Paim, P.S.G., Leipnitz, I.I., Rosa, A.L.Z. and Rosa, A.A.S., 1997. Preliminary report on the occurrence of Chancelloria sp. In the Itajaí basin, southern Brazil. Revista Brasileira de Geociências. 27(3): 303-308.
Rostirolla, S., 1991. Tectônica e Sedimentação da Bacia de Itajaí-SC, Mastership Dissertation presented to The Escola de Minas, Universidade Federal de Ouro Preto, 132p. (Unpublished).
Silva,L.C. and Dias, A, 1981. Os segmentos Mediano e Setentrional do Escudo Catarinense: II - Organização e evolução geotectônica. Acta Geol. Leopoldensia. 5(10):121-140.