



Pb-Pb isotope signature of Cu deposits in the Sul-Rio-Grandense Shield

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INTRODUCTION

The main metal deposits of the Sul-Rio-Grandense Shield occur in the Camaquã Basin, represented by the Cu and Pb-Zn deposits of the Camaquã and Santa Maria deposits, respectively. These metal deposits are hosted in sedimentary rocks and strongly controlled by fractures. One of the main aspects is the age and source of these deposits. Remus et al. (2000) and Laux et al. (2005) suggest that the main source of this mineralization of the Camaquã and Santa Maria deposits are related to magmatic-hydrothermal origin, with the metals derived from an old crustal-basement source during late Brasiliano orogeny the Dom Feliciano Belt, around 590 Ma. More recent works described the Bom Jardim Window, where occur the Santa Maria and Camaquã Deposits, as part of the Santa Bárbara Group. The units of the Santa Bárbara Group overlie the Acampamento Velho Fm., formed from 573 to 550 Ma. U-Pb detrital zircon data presented by Bicca (2009) provided zircon ages as young as 549±17 Ma confirmed that these sediments are younger than 573 Ma, and the mineralization is formed during the deposition of the Santa Bárbara Group or just after that. Based on the isotope signatures the source of Pb can be also recognized. This work presents Pb-Pb isotopes for the main stratigraphic units of the Camaquã basin and the adjacent regions (São Gabriel Terrane, Taquarém Terrane) and compared with those data of sulphide mineralization.

GEOLOGICAL SETTING

The Camaquã Basin occurs in the central part of the Sul-Riogrاندense Shield, Rio Grande Sul State, overlying the Paleoproterozoic and Neoproterozoic basement rocks (Chemale Jr. et al 1995, Paim et al 2000). It is a depositional locus of four major sequences or depositional cycles, the Maricá Formation, the Bom Jardim Group, the Acampamento Velho-Santa Bárbara Group and the Guaritas Group. The first depositional cycle, the Maricá Fm., starts with alluvial fans to braided alluvial sediments that grade up into shallow-marine to turbidite sediments. It is interpreted to be formed as a result of Dom Feliciano Belt overthrust in a retro-arc tectonic setting (Paim et al. 2000). Overlying the Maricá Formation are the three continental sequences, formed under the post-collisional stages of the Brasiliano Cycle, between 595 to ~500 Ma. The basal is the Bom Jardim Group, a volcano-sedimentary sequence formed from 595 to 578 Ma. Overlying in unconformity are the Acampamento Velho Fm., basal alkaline volcanic association, and the Santa Bárbara Group, a fluvial-deltaic-lacustrine sequence, formed from 578 to 540 Ma, and contains the fault-controlled Cu and Pb-Zn



mineralization. These units are covered by the Guaritas Group comprising aeolian and alluvial plain and fan deposits (~540 to 500 Ma).

RESULTS

Pb isotopes of WR samples of the volcanic rocks of the Acampamento Velho Fm. and of sulphide mineralization of the Camaquã-related Cu deposits were analyzed at the Laboratório de Geologia Isotópica of the UFRGS. In addition to that, the published Pb-Pb data are integrated to define the isotope trend of the main stratigraphic units of the basement rocks of the Camaquã Basin (Figs. 1 and 2).

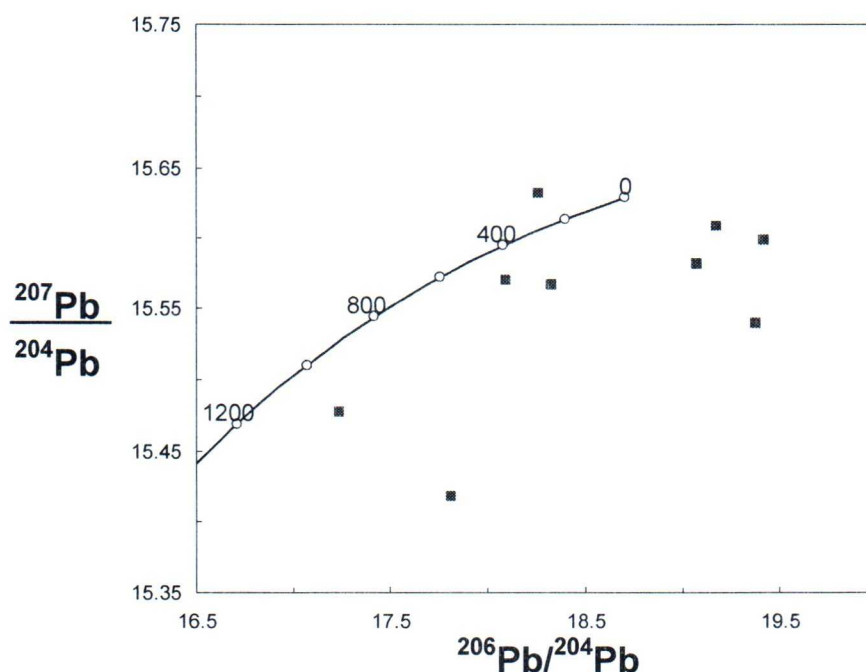


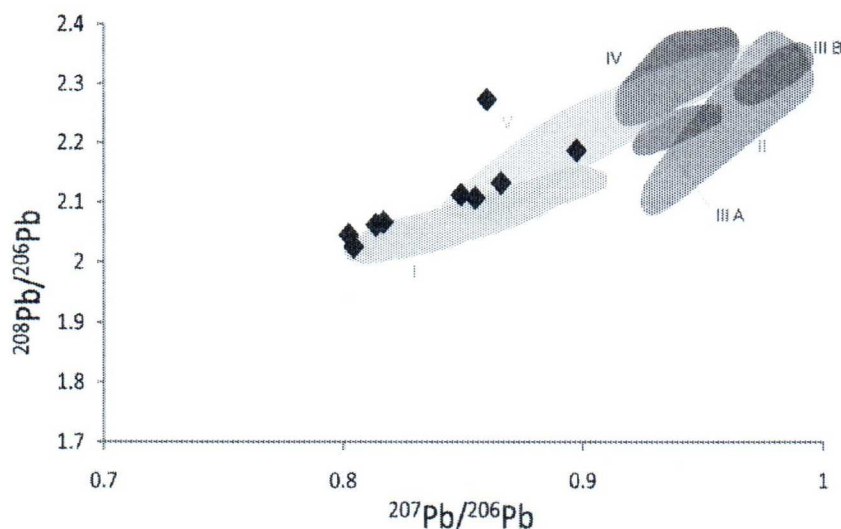
Figure 1. $^{206}\text{Pb}/^{204}\text{Pb}$ x $^{207}\text{Pb}/^{204}\text{Pb}$ diagram for the analyzed sulphide samples from the Cu-Camaquã Mine.

The analyzed sulphides associated with Cu-mineralization show a Pb-isotope signature of a mixed source with mantle and upper crust (orogenic environment after Zartman & Doe, 1981) and a low U-Pb ratio fluid (Fig. 1). Pb-isotope signature of the main rock associations of the Sul-Rio-grandense Shield can be observed in the figure 2. Most of the analyzed samples fall in the field of the 0.7-0.8 Ga juvenile rocks (as early Neoproterozoic ophiolite and magmatic arc) and the later granite melting (0.6 Ga) or in the field of the Ramada Plateau, the volcanic-sedimentary association formed from 0.57-0.55 Ga with some contribution of Paleoproterozoic crust (Field II).

The sulphides associated with Cu-Mine deposits do not have isotope signature as those of the Taquerembó Plateau, a dominant volcanic association chronocorrelate to the Ramada Plateau (0.55 to 0.57 Ga old). However these rocks have similar Pb-signature to the Paleoproterozoic Santa Maria Chico Granulite Complex (Field IV) and the reworked crustal granites of the Sul Rio-Grandense Shield (Field IIIB) with



Paleoproterozoic Pb-isotope source. This interpretation does not support the work hypothesis of Remus et al. (2000) who suggested that Pb was derived from old basement and from the sedimentary rocks of the Bom Jardim Group, when magmatic-hydrothermal fluids ascended through the volcano-sedimentary sequence.



- I = Juvenile signature (0.8-0.7Ga) II = Santa Maria Chico Complex (2.1-2.3 Ga)
 IIIA = Feldspar (0.5-0.6Ga) IIIB = Reworked Granites (0.54-0.60Ga)
 IV = Taquerembó Plateau (0.54-0.57Ga) V = Ramada Plateau (0.54-0.57 Ga)

Figure 2. $^{208}\text{Pb}/^{206}\text{Pb}$ x $^{207}\text{Pb}/^{206}\text{Pb}$ diagram for the main units of the Sul-Rio Grandense Shield and sulphide mineralization (◆).

CONCLUSIONS

Samples formed during the early to late stages of the Brasiliano Cycle (field I, Fig. 1) have a lower $^{208}\text{Pb}/^{206}\text{Pb}$ and $^{207}\text{Pb}/^{206}\text{Pb}$ isotope ratios when compared to those Brasiliano recycled crust (fields IIIA, IIIB and IV, Fig. 1). The latter ones have very similar trend as the Paleoproterozoic Santa Maria Chico granulite Complex, situated southwestern of the Camaquã Basin.

The Cu mineralization of the Camaquã Basin is strongly controlled by the tectonic features (faulting) and coeval or somewhat later than $549 \pm 17\text{Ma}$ (Bicca, 2009) with magmatic-hydrothermal origin (Remus et al 2000, Laux et al. 2005). The presented results suggest also that the Pb isotope sources of the Cu and Pb-Zn sulphides are very distinct. The mineralization processes occurred due to a very expressive tectono-hydrothermal-magmatic event ranging from 550 to 540 Ma, with contribution of the juvenile rocks and crustal reworked rocks of the Sul-Rio-Grandense Shield. The probable source for Pb-isotopes of the Cu-sulphide mineralization is related to the Neoproterozoic juvenile crust of the Sul-Rio-grandense Shield with some contribution of a Paleoproterozoic component.



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