Mineralogical and geochemical evolution of metal- and organic-rich horizons in Proterozoic, fine-grained siliciclastic rocks of the Vazante-Paracatu Zn-Pb mining district, Minas Gerais, Brazil: Constraints on metal sources for sediment-hosted zinc and lead deposits

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The Proterozoic carbonate-hosted Vazante – Paracatu Zn-Pb mining district, Minas Gerais, Brazil, provides most of the zinc resources in Brazil. The mineral deposits are hosted in dolomitic units of the Vazante Group. Zinc mineralization occurs in different styles as both Zn silicates (e.g., Vazante mine), and as Zn and Pb sulphides (e.g., Morro Agudo mine) hosted in different parts of the Vazante Group stratigraphy. Fine-grained siliciclastic sequences occur at the base of the Vazante Group (Serra do Garrote Formation), as well as other such units interbedded (Lower Pamplona Formation and Mocambo Member); with the Vazante Group carbonates. These deposits have been interpreted to form as the result of interaction of metalliferous, hydrothermal fluids with different fluids in the trap zones: hydrocarbons in the case of Zn-Pb sulphide deposits, evolved meteoric water in the case of zinc-silicate deposits. While the metal-bearing hydrothermal fluids in both styles appears to be similar in the sulphide and silicate ore zones, the ultimate sources of base metals, and elements associated with mineralization and alteration transported by the hydrothermal fluids are unknown. We are investigating the hypothesis that these siliciclastic horizons are the ultimate sources of base metals for the carbonate-hosted ore deposits of the Vazante Group. By analysis of the mineralogical features of the siliciclastic units, we are documenting their evolution through the stages of sedimentation, diagenesis, deformation and alteration, thus establishing the paragenetic history of these units in relation to the formation of the individual mineral deposits. This has been done using sedimentological analysis to understand their depositional setting and original composition, detailed petrographic analyses using microscopy and electron-microprobe microanalysis (EMPA), and X-ray diffraction (XRD) techniques to document the clays and micas associated with unaltered and altered units, whole-rock geochemical analyses for major and trace elements, and organic-carbon. Our initial results indicate that the Serra do Garrote Formation contains several different sedimentary sequences in a 1 km thick package that is distributed over a 200 km trend. Some of these units are enriched in ore-related elements and this enrichment occurred prior to the main hydrothermal event that formed the Zn-Pb deposits. Integration of these mineralogical and geochemical analyses will enable reconstruction of the fluid-rock interaction history of the Vazante Group, and the identification of possible zones of depletion of ore-related elements in the source rocks. This will lead to a better understanding of the Vazante – Paracatu ore-system and ultimately, will improve exploration models for sediment-hosted Zn-Pb deposits.