Evaluation of ^{224}Ra as a SGD tracer in Long Island Sound

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Introduction

In this work we present the Ra mass balance used to evaluate the importance of the submarine groundwater discharge (SGD) in Long Island Sound (NY, US). Long Island Sound is a large estuary on the east coast of the U.S. located between Long Island and Connecticut. It has a mean depth of 20m and tidal ranges up to 2 m with mud deposits that cover 67% of the western basin. In summertime, it is affected by hypoxia in the western basin. Three surveys were conducted between April 2009 and August 2010 where 25 water stations were sampled for Ra isotopes, oxygen concentration and Mn. Stations were oriented along 4 transects: one axial extending from the western to eastern Sound and three longitudinal transects in the western, central and eastern Sound.

Results and Conclusion

The inventory of ^{224}Ra in the water column in summer was two times higher than in winter pointing out an increased ^{224}Ra flux to the Sound in summer. A mass balance for ^{224}Ra was constructed considering tidal exchange and the inputs from rivers, desorption from particles, diffusive fluxes (including bioirrigation) and the loss due to radioactive decay. Diffusive fluxes of ^{224}Ra from bottom sediments have been measured by incubating cores in a continuous flow mode such that the overlying water was circulated through a Mn-oxide fiber to maintain a constant activity of ^{224}Ra. Diffusive fluxes from muddy sediments are about five times greater than those from sandy sediments. The Ra balance shows a net input of Ra to the Sound that could be attributed to fresh SGD, tidal recirculation through the beach sands or seasonal difference in the diffusive flux from sediments. ^{224}Ra values within 100 m of the shore were ten times those in the open sound. Radium concentrations were elevated in the pore water of the coarse beach sand along the Long Island and Connecticut coasts, suggesting that tidal recirculation through the beach face is an important source of Ra to the Sound. Seasonal variation in this source seems unlikely and we conclude that the variations seen in the ^{224}Ra inventories are probably produced by variations in sediment fluxes due to seasonal changes in bioirrigation and/or redox cycling of Mn.

Tourmalinites of the Brusque Group in the São João Batista-Tijucas area, Santa Catarina State – Brazil

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Introduction

The Dom Feliciano Belt is the most important geotectonic unit of the southern portion of the Mantiqueira Province in southern Brazil. In eastern Santa Catarina State, it is represented by the Itajaí and Brusque groups and the Florianópolis Batholith.[1] The basal Rio do Oliveira Formation of the Brusque Group is constituted from top to bottom by metapsammitic, metapelitic, metavolcanic-exhalative and metabasic/calc-silicate units. Within the metavolcanic-exhalative unit, a discontinuous tourmalinite sequence stretches out for approximately 14 km, from São João Batista to Tijucas.

The tourmalinites of the São João Batista-Tijucas area

Two types of tourmalinites are distinguished in the São João Batista-Tijucas area. Those cropping out along the Oliveira River are banded, very fine-grained, and are composed of greenish yellow tourmalines. In contrast, those cropping out in the Morro do Carneiro are coarse-grained and massive to slightly foliated. The tourmalines are typically zoned, with a transparent core, a darker intermediate zone, and a greenish rim.

Electron probe microanalyses showed that the tourmalines of the Oliveira River tourmalinites are Al- and alkalis-rich, whereas those of the Morro do Carneiro tourmalinites are Mg- and Ca-rich. The Morro do Carneiro tourmaline color zoning corresponds to an increase in Mg# and decrease in Al, alkalis and Fe contents from the light core to the greenish rim. The sharp increase in Ca contents from core to rim may be explained by Ca input from the surrounding calc-silicate rocks. On the other hand, the Oliveira River tourmalines are Ca-poor and Al-rich.

Geochronological studies by LA-ICPMS helped distinguish four zircon age groups.[2] Detrital zircons from the Rio do Oliveira Formation basal rocks yielded ages in the 2101-2150 Ma interval, interpreted as those of the source rocks for the Brusque Group metasediments. A second zircon population yielded 1090 ± 230 Ma, age characteristic of the 'adjacent' Namaqua Metamorphic Complex (in Western Gondwana). The zircon age obtained for the Rio do Oliveira Formation basal amphibolites is 639 ± 11 Ma, which is considered the maximum age of the overlying banded tourmalinites. Younger ages, between 608 and 581 Ma, correspond to the thermal event associated with the Neoproterozoic granitic magmatism. These ages may correspond to the age of formation of the Morro do Carneiro massive tourmalinites.

Conclusions

The Rio do Oliveira tourmalinites formed by selective substitution caused by B-rich exhalative fluids affecting the sediments of the metavolcanic-exhalative unit, whereas metasomatic/igneous fluids led to the formation of the Morro do Carneiro massive tourmalinites. Zircon dating showed that the Rio do Oliveira tourmalinites are somewhat older than the Morro do Carneiro massive tourmalinites.

[1] Basei et al. (2011) *Journal of South American Earth Sciences* **32**, 324–350. [2] Brentan (2011) *Unidades turmaliníferas do Grupo Brusque, Rio do Oliveira, Tijucas, SC* (unpublished Graduation Monograph).