Provenance and post-sedimentary low-temperature evolution of the James Ross Basin sediments (Antarctic Peninsula) based on zircon and apatite fission-track analysis

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James Ross Basin contains one of the thickest and most complete Jurassic-Paleogene age sedimentary successions anywhere in the Southern Hemisphere. The basin is filled by a sequence of arc-derived clastic and volcaniclastic marine sediments through the Late Jurassic to Late Eocene.

In order to reconstruct thermal history for basin low-temperature evolution of potential sedimentary resources and post-sedimentations succession, we dated detrital zircons and apatites from the sequence of sandstones collected from the James Ross and Seymour Islands using fission-track (FT) thermochronology. All zircon FT ages are older than apatite FT ages provided in the identical individual rocks. Provenance of individual FT zircons and apatites ages varies in wide spread of Carboniferous to Early Paleogene ages between ~60 to ~350 Ma. Jurassic-Cretaceous ages of northwest James Ross Island are probably compatible with derivation of sediment from western lying Mt. Reece and Mt. Bradley region, where the rocks of the Antarctic Peninsula batholith appears.

Sediments from Seymour Island are probably originating from Trinity Peninsula Group and Antarctic Peninsula Volcanic Group. Shortening of tracks was due to subsequent volcanic/magmatic activity before transport of rocks and deposition into the James Ross Basin or alternatively, due to volcanic reheating after deposition.

Time-temperature modelling of the apatite fission-track samples from Seymour Island (Marambio and Seymour Island Groups) shows a similar thermal history style, involving a period of total thermal annealing and subsequent cooling (erosion/denudation). The samples were above 120ºC until about the Upper Triassic (220 – 210 Ma) age and then followed by the period of relatively quick Neogene and Quaternary exhumation (since ~30 – 40 Ma) to the present erosion surface.

Isotopic and trace element evidence for groundwater discharge in the coastal zone

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Determination of the relative importance of freshwater discharge from surface and groundwater sources into coastal estuaries and lagoons is important in making assessments regarding water control policies. In this study, variations in δD, $\delta^{18}O$, $\delta^{13}C$, and concentrations of Sr, Ba, and Mg relative to Ca have been used to disinguish the input of fresh groundwater from rainwater and surface discharge into coastal ecosystems of South Florida (Biscayne Bay and Florida Bay). These tracers are able to distinguish between these various sources, because rainwater has relatively negative $\delta^{18}O$ and δD values and low concentrations of cations. Groundwater also has depleted $\delta^{18}O$ and δD, but low Sr/Ca, Mg/Ca, and Ba/Ca ratios. In contrast, surface waters have relatively positive $\delta^{18}O$ and δD values, intermediate concentrations of Ca, high concentrations of Ba, and negative $\delta^{13}C$ values (SWART and PRICE, 2002). The differences in the geochemical parameters arise because (i) surface waters in South Florida are highly evaporated thereby enriching δD and $\delta^{18}O$ values, (ii) surface waters are highly influenced by surface organic activitity which produces waters depleted in $\delta^{13}C$ and elevated in Ba, (iii) groundwaters dissolve the local carbonate rocks which contain high concentration of Ca, but relatively low concentrations of Ba, Sr, and Mg; these waters also contain relatively positive $\delta^{13}C$ values. Our results indicate that within Florida Bay, the input of fresh groundwater contributes an insignificant amount to the hydrological balance. Instead the salinity is controlled by runoff and precipitation. In contrast in Biscayne Bay, groundwater, surface water, and direct precipitation all contribute equally to the salinity balance.

Reference

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