Paper Number: 5126

Detrital record of tectonic and climate interactions during Gondwanide orogenesis from the lower Ecca Group, Karoo basin, South Africa

Weislogel, A.L.[1], McKay, M.P.[1], Dean, J.R [1], Findlay, C.P.[1] and Fildani, A.[2]

[1] Dept. of Geology & Geography, West Virginia University, Morgantown, WV, amy.weislogel@mail.wvu.edu

[2] StatOil, Austin, TX

Detrital zircon geochronology, along with mudstone and volcanic tuff geochemistry, on deepwater deposits of the lower Ecca Group in the Karoo basin reveal an intimate interplay between sediment influx, regional tectonism, and basin-water circulation. Sediment caliber of lower Ecca Group deepwater facies varies from very fine to fine-grained sandstone and interbedded mud of the Laingsburg sub-basin in the west, to very fine to medium-grained sandstone and interbedded mud of the Ripon sub-basin to the east. Despite the grain size difference, provenance records for these two sub-basins are markedly similar. Detrital zircon signatures of lower Ecca Group sandstone display an upsection decrease in Permian-aged detrital zircon grains (Laingsburg: 55% to 24%; Ripon: 57% to 48%) and increase in Paleozoic to Neoproterozoic detrital zircon grains (Laingsburg: 45% to 75%; Ripon: 43% to 51%). Mudstone composition is overall generally consistent throughout lower Ecca Group deposition, with quantitative XRD results indicating abundant albite (>10-20%) and quartz (20-40%) in most samples. Bulk rock geochemistry results yield values for the Chemical Index of Alteration that are generally low (<75). Rare earth element abundances display LREE enrichment and negative Eu anomalies; this, together with trace element relationships, indicate a mix of chemically juvenile and evolved source areas provided mud to the Lower Ecca Group. The εNd isotopic signatures of lower Ecca Group mudstones show a slight decrease upsection, reflecting input of sediment from progressively older source rocks through time. Together, these provenance data indicate lower Ecca Group sedimentation reflects initial clastic influx derived from the Late Paleozoic Gondwanide magmatic arc, with later sediment influx increasingly derived from erosion of Paleozoic Cape Supergroup metasedimentary rocks in the growing Cape fold belt. Notably, a few mudstone REE patterns display significant negative Ce-anomalies (-0.10 to - 0.22). Since neither the sediment source rocks nor interbedded tuffs display REE patterns with negative Ce-anomalies, these anomalies are interpreted to reflect oxygenation of Karoo basin bottom-waters during Lower Ecca Group deposition, with oxygenation in the Ripon sub-basin occurring first and lasting longer compared to relatively short-lived oxygenation in the Laingsburg sub-basin. Bottom-water oxygenation could have been related to an increase in drainage discharge to the basin, either by growth of more extensive drainage catchments, or by development of a wetter climate. Alternately, a change basin configuration, such as bathymetry or connection to the Panthalassic ocean, could also have produced oxygenated bottom-water conditions.