

Geochemical study of a marine shelf in SW-Gondwana: The aftermath of Neoproterozoic glaciations

M. VELASQUEZ^{1*}, J.E. SPANGENBERG¹, C. GAUCHER²
AND P.C. BOGGIANI³

¹IMG, UNIL, Switzerland (*Mariluz.Velasquez@unil.ch,
Jorge.Spangenberg@unil.ch)

²Dept. of Geology, Univ. of Montevideo, Uruguay

³Inst. of Geosciences, Univ. of Sao Paulo, Brazil

The Neoproterozoic to Cambrian sediments of the Corumbá Group (CG, SW-Brazil), the Arroyo del Soldado Group (ASG, Uruguay), and the Sierras Bayas Group (SBG, Argentina), have been investigated by a combination of inorganic and organic geochemical methods, to determine major, trace and rare earth element (REE) concentrations, hydrocarbon distribution, and stable isotope ratios of carbonates ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) and associated kerogen ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$). These units were deposited on an extensive marine shelf covering the Rio de la Plata Craton, SW-Gondwana.

The CG samples record higher concentrations of redox sensitive elements (Fe and V) and ΣREE , a slightly positive Ce anomaly (0.1 to 0.3) and positive $\Delta^{13}\text{C}_{\text{carb-ker}}$ excursions of ~5‰. Abundant pyrite and a biomarker distribution including series of alkylbenzenes, traces of gammacerane as well as a low Pr/Ph ratio (~0.7) are also remarkable signatures from these samples.

The geochemical study of the ASG samples reveals $\delta^{13}\text{C}_{\text{carb}}$ excursions ranging from -5.7 to 5.4‰ (coeval in CG and ASG) and a strong $\delta^{13}\text{C}_{\text{org}}$ enrichment (up to -12‰). Some taxa-specific biomarkers identified in these samples are: 7-Methyl heptadecane, confirming a cyanobacterial contribution; acyclic isoprenoids of less than 21 carbons indicating the involvement of cyanobacteria, algae and/or phototrophic bacteria; a series of alkylcyclohexanes which has been associated with a bacterial origin and steranes, produced exclusively by aerobic eukaryotes and indicating a diverse community of algae.

Due to the absence of sulphate minerals to explore the sulphur isotopic system, we will determine the $\delta^{34}\text{S}$ values of the structurally substituted carbonate-associated sulphate (CAS) in samples of SBG.

These observations point to a stratified ocean in the aftermath of Neoproterozoic glaciations with oxic surface waters and anaerobic conditions at the bottom. A microbial consortium including sulfate reducing and green sulfur bacteria from CG samples implies the existence of an sulfidic and reducing setting in the photic zone. High bioproductivity at the surface could be the trigger factor.

The origin of fossil groundwater from the Nubian sandstone aquifers in the Middle East: A multi-isotope (Ra, B, Sr, S, O, H) investigation

AVNER VENGOSH^{1*}, GARY S. DWYER¹, OMAR RIMAWI²,
ABDALLAH AL-ZOUBI², AMER MARIE³
AND JIWCHAR GANOR⁴

¹Division of Earth and Ocean Sciences, Box 90227, Duke
University, Durham, NC 27708 USA

(*correspondence: vengosh@duke.edu)

²Al-Balqa' Applied University, Salt, 19117, Jordan

³Al-Quds University, Betany, PO Box 89, East Jerusalem,
Palestine

⁴Ben Gurion University, PO Box 653, Beer Sheva, 84105,
Israel

The rise in population, consecutive droughts, and associated increased water demands in the Middle East have placed an increasing pressure on available water resources, which in turn has accelerated the rates of their depletion and salinization. In addition to desalination and recycling wastewater, exploitation of non-renewable ("fossil") groundwater has become an alternative water source. Recent findings have shown, however, that fossil groundwater from the Nubian Sandstone aquifers in Jordan and Israel has high levels of naturally occurring and carcinogenic radium isotopes that largely exceed the international drinking water standards, and poses a health risk upon long-term utilization [1]. This study investigates the origin of fossil groundwater from the Cambro-Ordovician Disi-Mudawarra aquifer system in southern Jordan using water (O, H) and dissolved constituents (Sr, B, S, and Ra) isotopes. Variations in the oxygen and hydrogen isotope ratios reveals several recharge events to the aquifer that were derived from different air masses with $\delta^{18}\text{O}$ fluctuations from -7.5‰ to -5.7‰, inferring different climate conditions. The relationships between $\delta^{11}\text{B}$, B/Cl, $^{87}\text{Sr}/^{86}\text{Sr}$, and $\delta^{34}\text{S}$ in the low saline groundwater from the confined zone of the Disi aquifer suggest that the original recharge water has preserved its original rainwater composition with minimal water-rock interactions and mixing. The combined high $\delta^{11}\text{B}$ and B/Cl signals suggest origin from marine aerosols in which the ^{11}B -enriched boric acid was generated from seawater. Reconstruction of the origin of the groundwater by independent isotopic tracers provides further validation for age-dating determination of fossil groundwater.

[1] Vengosh *et al.* (2009) *Environ. Sci. Technol.* DOI: 10.1021/es802969r.