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EDITORIAL
EXPLORING THE GEOCHEMISTRY AND BIOGEOCHEMISTRY OF MODERN AND ANCIENT SEDIMENTARY SYSTEMS

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Sedimentary rocks are our window to understand the history and evolution of the surface of our planet. The sedimentary record, although biased by variable preservation conditions and post depositional processes, potentially preserve signals of the interaction between physical, chemical and biological processes that takes place at the interface between the **Geosphere**, the H**ydrosphere/ Atmosphere** and the **Lithosphere**. **Geochemistry**, integrated with **Sedimentology**, has become a standard approach to unravel these interactions and to provide some insights for the understanding of how sedimentary geochemistry is preserved within different sedimentary environments.

Microbial life is ubiquitous at the Earth's surface (Whitman *et al.*, 1998), and has been present throughout our Planet's history. It has evolved to exploit the energy provided by gradients in geochemical composition between rocks, organic materials and surface fluids, using this energy for maintenance and growth (Hoeler, 2007). Due to their abundance, chemical reactivity and metabolic activity (Konhauser, 2007), microbes play a central role in biogeochemical cycles (C, O, N, S, Fe, etc) at both, micro and macroscopic scales (Schlesinger and Bernhardt, 2020). The best example of these processes are the current chemical composition of our O2-rich atmosphere or the chemical redox gradients that exist at the sediment-water interface in most sedimentary environments around the world, where early diagenesis driven by organic matter degradation takes place (Aller, 2014). In addition, microbial mats and biofilms influence the precipitation/dissolution of minerals such as carbonates (explaining the the abundance of **microbialites** in the ancient rock record, Riding, 2011) as well as the rheological and mechanical behaviour of detrital sediments, where a classic example are known as **MISS** (*Microbially induced sedimentary structures*, Noffke *et al.*, 2010). For these reasons, whenever we talk about sedimentary geochemistry we are actually talking about sedimentary **biogeochemistry** and **geomicrobiology**. This is so since microbial activity has been shaping the surface chemistry and composition of our planet, as previously recognized by the pioneering work of Vladimir Vernadsky in 1926 and later by Lourens Baas-Becking in 1934 (Knoll *et al.*, 2012). Vernadsky and Baas-Becking early ideas have grown and become the lens through which we scientifically observe our world, making it clear that the **Biosphere** adds another layer of diversity and complexity in order to understand our planet as a system.

This special issue is titled: ***Exploring the geochemistry and biogeochemistry of modern and ancient sedimentary systems***. It is dedicated to papers that integrate ***Sedimentology***, ***Biogeochemistry*** and ***Geobiology*** of modern and/or ancient sedimentary systems. In this special issue, on page 101, Arrouy *et al.* (2021) show an interesting record within the well-known Loma Negra Formation limestones, in the Tandilia System. This is a unique record of Neoproterozoic age in our country, that show a diversity of microbially associated sediments such as **MISS**, and a diverse set of stromatolites and microbial mats related structures that these authors explore from a sedimentology as well as geochemical perspective. By doing this, they provide a new and interesting data set of major, minor and trace element geochemistry in this interesting unit. The authors recognize the unusual record of bubble-like morphologies associated with gas bubbles trapped within the sediments, suggesting the presence and influence of microbial mats. By using geochemical redox proxies the authors suggest that these recognized structures may be associated with oxygen production due to photosynthetic activity during the Middle Ediacaran, preserved in the Loma Negra Formation. The Ediacaran has been a fascinating geologic period due to important changes in atmospheric and ocean chemistry as well as paleobiological evolution, and the contribution by Arrouy *et al.*, (2021) add new useful information and interesting ideas to provide insight to this unique period of our planet's history.

On page 121, Maisano and colleagues (see Maisano *et al.*, 2021) give a new twist to the well-known MISS (cf. Noffke, 2010) by showing an interesting case at Paso Seco (northern coastal Patagonia), focused on coastal siliciclastic sediments colonized by microbial mats. Here the authors show how the presence of microorganisms, and the exopolymeric substances (EPS) these produce, influence the permeability through the sediments. This, together with evaporative environmental conditions, influence mechanical behaviour of these sediments as well as the mineral chemical equilibrium inducing mineral precipitation (carbonates and gypsum). This helps to the immobilization of the bedforms (ripples), promoting their early lithification and thus influencing their potential preservation. Thus, the interesting observations provided by Maisano *et al.*, (2021) can be extremely useful to better understand the geological record of similar structures in these and similar settings.

In the last contribution to this special issue, on page 133, Eymard *et al.* (2021), focuses on carbonate microbialites recorded in the Maquinchao basin, in northeastern Patagonia, Argentina. These authors, by combining an interesting set of techniques such as 16SrRNA-based microbial diversity studies, hydrochemistry, SEM microscopy and field sedimentology and mineralogy analysis explore the intrinsic and extrinsic processes that control carbonate precipitation within the Maquinchao microbialites. As they suggest, seasonal changes in the physico-chemical conditions and the hydrochemistry, together with other extrinsic processes such as increased evaporation, might be dominant and thus triggering carbonate precipitation within these microbialites. Thus, the role of intrinsic biological processes such as mineral precipitation due to photosynthetic activity may be diminished, particularly when the influence of these recognized extrinsic factors dominate. Thus, biotic and abiotic processes may have different degrees of participation in microbialite formation during their growth history. Unravelling the contribution of these different but related controls may be critical to better understand how the environmental conditions are recorded within microbialites, biosignatures preservation and their utility as paleoclimate archives, and this highlights the relevance of Eymard *et al.* (2021) contribution.

Due to COVID-19, the transition from 2019 to 2021 has been globally challenging for our society in different ways. Currently we are still facing these challenges since Covid-19 cases are apparently skyrocketing. In particular, the closure of most research institutions, laboratories and different analytical facilities, as well as the difficulties to accomplish field and other research activities has been a big bump for most researchers in order to advance their research projects. This has strongly impacted the access to field and analytical data that allow further work to be later published. For these reasons we are grateful to the authors that contributed to this special issue since we know from first-hand the challenges and difficulties that they have been facing in order to produce the invaluable contributions submitted to this special issue. For this we say ***Thank You very much*** for your support, willingness and patience and we invite you all to read and become familiarized with their work. We hope that this triggers other researchers to submit their research integrating these fascinating disciplines to our **Latin American Journal of Sedimentology and Basin Analysis**.

With our kindest regards we wish you the best for this 2022, stay healthy,

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