Interactions at the cell-mineral interface

M.E. ROMERO-GONZALEZ*, Z. ZHANG, J.S. ANDREWS, M. GEOGHEGAN, L. SWANSON, J. SCHOLES, S. ROLFE AND S.A. BANWART

Cell-Mineral Research Centre. Kroto Research Institute. The University of Sheffield, Sheffield S3 7HQ, UK (*correspondence: m.e.romero-gonzalez@sheffield.ac.uk)

The physical and chemical interactions of cell macromolecules with solid substrata is a primary mechanism essential to an enormous range of microbial processes in microbial geochemistry, microbial biotechnology and biomedical engineering and. These phenomena are strongly influenced by the pioneer encounters of macromolecular structures of the cell wall with solid substrata such as mineral surfaces. We have developed an integrated approach to studying cell surface chemistry that includes simplified chemical systems of pure compound biopolymers as models of the cell wall. The specific polymer selected to construct the model cell surface is based on the known physiology of key classes of bacteria. Our work has focussed on specific strains of the genera *Rhodococcus*, *Pseudomonas* and *Sphingomonas*. These biological models are selected due to their respective cell wall structures. Chemical characterisation of polysaccharides, proteins and nucleic acids present in outer layers of these bacterial strains were extensively studied by FT-IR and Raman microspectroscopy, zeta potential, potentiometric titrations and XPS. These were also compared with quantification of attached growth in live cultures. The interfacial physical chemical changes that occurred due to interactions with a range of minerals were also studied. Mycolic acids were studied by AFM since they are proposed to play a key role in the adaptation of Rhodococcus to effectively anchor cells to solid substrata with a range of surface properties. Parameterisation of mathematical models of colloidal force interactions using the Extended DVLO theory, allowed a quantitative interpretation of the contribution of ionic charge and solvent interactions to cell binding at the mineral surface.

These studies have shown that for diverse organisms, general characterisation of cell and substratum properties (i.e. hydrophobicity) did not strongly distinguish between the tendency for attachment to a surface and subsequent biofilm growth. Microscopic and spectroscopic techniques showed that extracellular macromolecules influential in cell attachment to surfaces, biofilm formation and structure were genus specific within the strains tested. The future challenge is then to elucidate the role of common model compounds on cell binding mechanisms.

New opals from Wollo, Ethiopia: Geochemical characterization

B. RONDEAU[1]*, E. FRITSCH[2], B. TOK[3] AND F. MAZZERO[4]

[1]Université de Nantes, CNRS-UMR 6112, BP9208, 44322 Nantes, France (*benjamin.rondeau@univ-nantes.fr)
[2]Université de Nantes, IMN, CNRS-UMR 6205, BP 32229, 44322 Nantes, France
[3]Institute of Geological Sciences, Bern, Switzerland
[4]Opalinda, 56 rue Lafayette, 75009 Paris, France

A new deposit of precious opal has been discovered in 2008 close to Wegel Tena, Wollo Province, Ethiopia [1]. It occurs about 350 km North of the deposit of Mezezo, Shewa Province, which is mined since the 1990's. Opals from Wegel Tena occur in a specific horizontal level of a thick rhyolite-basalt sequence about 30 Ma old. These volcanics are related to the East-African rift. When unaltered, the opal host-rock is an alkaline rhyolite. At the contact with the opal veins, quartz is absent (it has probably been dissolved to form opal) and some feldspars grains are apparently etched: this suggests that opal formed through an alteration process of the rhyolite.

We measured the chemical composition of opals using a SEM equipped with EDS and a LA-ICP-MS for major and trace elements respectively. Opals from Wegel Tena contain minor amounts of Al (1000 to 1900 ppm), Ca (350 ppm) and K (250 ppm). Trace elements are present in amounts comparable with those in opals from Mezezo [2], with the following notable exceptions: Y (0.1 ppm), Nb (1 to 3 ppm) and Th (<0.01 ppm) are lower in Wegel Tena material, whereas Sc (1.5 to 2 ppm), Rb (40 to 75 ppm), Sr (70 to 160 ppm) and Ba (140 to 230 ppm) are higher. The high Ba concentration in opals from Wegel Tena is surprising: compared to opals from all over the world [2], all opals formed in a volcanic environment usually have a low Ba concentration (below 100 ppm) whereas those formed in a sedimentary environment are Ba-rich (100 to 300 ppm).

[1] Rondeau *et al*. (2009) *Gems & Gemology*, **45**, 59-60. [2] Gaillou *et al*. (2008) *Ore Geology Reviews*, **34**, 113-126.