Highly Swellable Glass Composite Materials For *In Situ* Groundwater Remediation and Organic Vapor Permeable Proppants

PAUL L. EDMISTON[1,2*], DEANNA C. PICKETT[2], JEAN QUENNEVILLE[1]

[1]College of Wooster, Ohio, USA pedmiston@wooster.edu (* presenting author)

[2]ABSMaterials, Wooster, Ohio, USA, d.pickett@absmaterials.com

Abstract

Osorb is an organosilica material that swells in contact with organic compounds, but is impermeable to water. Swelling is substantial leading to absorption of up to 8 times the dry mass of the initial material with concomitant generation of mechanical forces in excess of 500 N/g [1]. The unique properties lead to a wide variety of sub-surface applications. Iron-Osorb® is a solid composite material of swellable organosilica with embedded nanoscale zero-valent iron that was formulated to extract and dechlorinate solvents in groundwater. The unique feature of the highly porous organosilica is strong affinity for chlorinated solvents, such as trichloroethylene (TCE), while being impervious to dissolved solids. The swellable matrix is able to release ethane after dechlorination and return to the initial state. Iron-Osorb was determined to be effective in reducing TCE concentrations in bench-scale experiments. A series of three pilot scale tests for *in situ* remediation of TCE in conjunction was completd in conjunction with the Ohio Environmental Protection Agency at a site in central Ohio [2]. In addition, Osorb has wide ranging uses in the oil and gas industry. The material has been evaluated for use as an proppant additive for selective and enhanced flow rates of hydrocarbons in wet environments, water management, and down-hole tooling.

[1] Burkett, C. M.; Underwood, L. A., Volzer, R. S.; Baughman, J. A.; Edmiston, P. L. (2008) *Chemistry of Materials* **20**, 1312-1321.
[2] Edmiston, P.L.; Osborne, C.; Reinbold, K.P.; Pickett, D.C.; Underwood, L.A. *Remediation Journal*, **22**, 105-121.

From tectonic gateways to diatoms: the build-up to Antarctic glaciation

KATHERINE E. EGAN[1*], ROSALIND E.M. RICKABY[1], KATHARINE R. HENDRY[2], ALEX N. HALLIDAY[1]

[1]University of Oxford, Oxford, UK, katherine.egan@exeter.ox.ac.uk (* presenting author)

[2] School of Earth and Ocean Sciences, Cardiff University, Cardiff, UK, (HendryKR@cardiff.ac.uk)

The Eocene-Oligocene boundary witnessed an end to the Earth's greenhouse climate and the abrupt initiation of modern icehouse conditions. Understanding the mechanisms which drove this fundamental shift is essential to a better comprehension of rapid climate response to gradual forcing. It has been suggested that enhanced marine organic carbon export and burial contributed to a drawdown of atmospheric CO_2 which triggered Antarctic Glaciation. We investigate this theory using the novel combination of sponge $\delta^{30}Si$ (a proxy for deep water silicic acid concentration, results from this study and [1]) and diatom $\delta^{30}Si$ (indicating diatom nutrient utilisation) at ODP sites 689 (sponge) and 1090 (diatom) in the Southern Ocean.

Our records, spanning 38-31Ma, document a dramatic increase in Southern Ocean intermediate/deepwater silicic acid concentration between ~35.5Ma and 34.5Ma. A build up of diatom production and global carbon export from 35.5Ma to the Eocene-Oligocene boundary is also implied. We hypothesise that prior to 35.5Ma ocean circulation was sluggish and driven by sinking at high southern latitudes. This drew down surface waters advected from the equatorial regions, bathing the seafloor in a low nutrient (and silicic acid) water mass, in a similar fashion to modern North Atlantic Deepwater. With ongoing subsidence of the Drake Passage and Tasman Gateway, a proto-Antarctic Circumpolar Current became established. From around 35.5Ma, this wind driven current increased the rate of ocean overturning and nutrient re-supply to surface waters, stimulating diatom productivity and increasing global organic carbon export. Thus, the gradual deepening of tectonic gateways prior to the establishment of permanent ice sheets on Antarctica may have driven organic carbon burial and contributed to the CO_2 drawdown that initiated glaciation.

[1] De La Rocha (2003) *Geology* **31**, 423-426