A highly stratified Cryogenian marine basin recorded in the Datangpo Formation, South China

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Changes in ocean redox chemistry during the Cryogenian are likely to have had a strong influence on the emergence of animals[1]. A detailed, multi-element (Fe-C-S-Mo) biogeochemical study was conducted for two outcrop sections reflecting different water depths for the ca. 663-654 Ma Datangpo Fm. The Datangpo was deposited between the two major Neoproterozoic glacial episodes (Sturtian and Marinoan) in the restricted Nanhua Basin, South China. Basinal restriction may have been a common feature throughout the world in association with widespread rifted margins during global sea-level lowstands, particularly during build-up of the Marinoan ice sheet. Our findings are consistent with a highly stratified basin in which water column chemistry was strongly controlled by Fe and other nutrient fluxes, low dissolved marine sulfate concentrations, varying inputs of marine organic carbon delivered via primary production, and changing sea-level. Sea level was the overarching control on much of the observed variation. A compilation of new and published S isotope data for the Datangpo Fm. suggests a ^{34}S-enriched deep marine sulfate pool generated, in part, during the Sturtian glaciation by bacterial sulfate reduction in combination with suppressed riverine sulfate inputs and restriction of the basin during a dramatic drop in sea level. This study highlights the importance of both global and local controls in determining the chemical conditions in Neoproterozoic basins.

[1] Love et al. (2009) *Nature* **457**, 718-721.

Fluid cell TEM shows direction-specific interactions control crystal growth by oriented attachment

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Introduction

Oriented attachment (OA) of molecular clusters and nanoparticles in solution is now recognized as an important mechanism of crystal growth in many materials, yet the alignment process and attachment mechanism have not been established. Here we performed high-resolution TEM using a fluid cell to directly observe attachment of iron oxyhydroxide nanoparticles. Images were recorded with lattice fringe-resolution, enabling us to track particle orientations throughout the experiments.

Results and Conclusion

We find that the primary particles undergo continuous rotation and interaction until they find a perfect lattice match. A sudden "jump to contact" then occurs over < 1nm, followed by lateral atom-by-atom addition initiated at the contact point. Interface elimination proceeds at a rate consistent with the curvature-dependence of the Gibbs free energy. From the measured translational and rotational accelerations we calculate the magnitude of the inter-particle forces. The results show that highly-direction-specific interactions drive crystal growth via OA, and are likely the result of electrostatic forces.

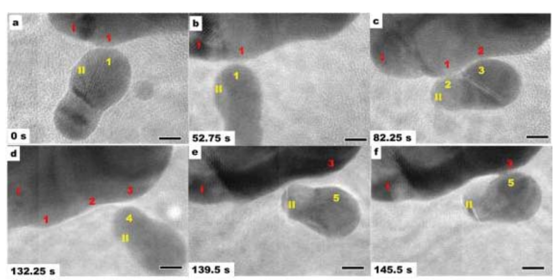

Figure 1: Typical dynamics of attachment process. Scale bar: 5 nm.

The findings of this study provide a dynamic view of the process of OA and answer the essential question of whether co-alignment occurs prior to attachment or comes about afterwards. In the case of freely diffusing nanoparticles, either near-perfect crystallographic orientation or a specific twin orientation that ensures interfacial coherence is required for attachment to occur. The results also shed light on the magnitude and nature of the forces that drive OA.