

# Clay mineral and isotopic evidence for widespread restricted, evaporitic conditions during the deposition of the Ediacaran Doushantuo Formation

SHUJUN HAN<sup>1,2</sup>, STEFAN LÖHR<sup>1,3</sup>, APRIL ABBOTT<sup>1,4</sup>,  
ANDRE BALDERMANN<sup>5</sup>, MARTIN VOIGT<sup>6</sup>, HUAN CUI<sup>7</sup>,  
BO CHEN<sup>8</sup>, JURAJ FARKAS<sup>9</sup>, GRAHAM A. SHIELDS<sup>10</sup>  
AND ALAN J KAUFMAN<sup>11</sup>

<sup>1</sup>Macquarie University

<sup>2</sup>China University of Geosciences Beijing

<sup>3</sup>University of Adelaide

<sup>4</sup>Coastal Carolina University

<sup>5</sup>Graz University of Technology

<sup>6</sup>Institute of Earth Sciences, University of Iceland

<sup>7</sup>Université de Paris

<sup>8</sup>Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences

<sup>9</sup>Metal Isotope Group, Earth Sciences, University of Adelaide

<sup>10</sup>University College London

<sup>11</sup>University of Maryland

Presenting Author: [shujun.han@students.mq.edu.au](mailto:shujun.han@students.mq.edu.au)

The Ediacaran Period witnessed major environmental change and an expansion of eukaryotic life following the Marinoan glaciation. Despite the Ediacaran Doushantuo Formation furnishing much of our understanding of the Earth System and biospheric evolution, its sedimentary environment remains disputed. Here we use a novel petrographic approach of SEM-EDS mineral mapping [1] to document the widespread and persistent occurrence of the Mg-rich clays saponite, talc and sepiolite across the Yangtze carbonate rimmed shelf. Saponite occurs both in proximal and in distal shelf settings, whereas talc and sepiolite occur only in distal settings. Slope and basinal settings are characterised by abundant illite, but no Mg-rich clays. The Mg-rich clays are of authigenic origin, forming in response to local water chemistry. Thermodynamic reaction path modelling and the absence of authigenic Mg-rich clays in deeper open marine settings demonstrate that while silica rich Precambrian seawater is a necessary prerequisite, locally restricted conditions leading to mild evaporitic concentration of seawater are required for the formation of authigenic Mg-rich clays. We identify a clear stratigraphic progression where the basal Doushantuo contains illite but Mg-rich clays appear shortly above the cap carbonate, consistent with existing palaeographic reconstructions suggesting the rapid development of an extensive carbonate rimmed lagoon on the Yangtze shelf. Interestingly, preliminary results suggest that the stratigraphic distribution of Mg-rich clays, indicating evaporitic conditions, is correlated with published carbonate carbon isotope data from the same localities. Stable Sr isotope work is currently underway to further test the scenario, following the reconnaissance studies in a modern lagoonal system [2]. In summary, our findings illuminate hitherto unsuspected temporal changes in the depositional environment of

the Doushantuo Formation. Restricted, evaporitic conditions were much more expansive than previously assumed, and likely influenced biogeochemical cycles, nutrient accumulation and biological radiations of the Doushantuo Biota.

[1] Quantitative petrographic differentiation of detrital vs diagenetic clay minerals in marine sedimentary sequences: Implications for the rise of biotic soils, Rafiei, M. et al (2020) *Precambrian Research* 350, 105948.

[2] Impact of salinity and carbonate saturation on stable Sr isotopes ( $\delta^{88}\text{Sr}/\delta^{86}\text{Sr}$ ) in a lagoon-estuarine system, Shao, Y. et al (2021) *Geochimica et Cosmochimica Acta* 293, 461–476.