Estonian Journal of Earth Sciences
2023, **72**, 1, 133

https://doi.org/10.3176/earth.2023.44

www.eap.ee/earthsciences
Estonian Academy Publishers

Distinguishing borings and burrows in intraclasts

Yazhou Hu[a], Luke C. Strotz[a], Dirk Knaust[b], Jiayue Wang[a], Yue Liang[a] and Zhifei Zhang[a]

[a] State Key Laboratory of Continental Dynamics, Shaanxi Key Laboratory of Early Life and Environments, Department of Geology, Northwest University, Xi'an 710069, China

[b] Technology, Digital and Innovation, Equinor ASA, PB 8500, 4035 Stavanger, Norway

Hardgrounds are surfaces of synsedimentarily cemented carbonate beds that form at or near the seafloor. They are concentrated in particular periods of the geological record and their presence is closely linked to main climatic and biological events. For example, it has been proposed that early lithification of carbonate sediments facilitated the substantial increase of biodiversity during the Great Ordovician Biodiversification Event. Thus, identification of hardgrounds forms an integral component in documenting both geological and evolutionary events in the early Palaeozoic.

Recognition of hardgrounds, including early Palaeozoic examples, is often not straightforward, usually because they lack encrustations and/or bioeroded grains and clasts. Due to the homogeneous texture of micrite, often bioeroded grains and clasts are hard to find and thus cannot be used for hardground identification. Hiatal surfaces, due to omission, are frequently associated with the development of hard substrate. Hiatal surfaces and hardgrounds are often characterised by occurrences of attached organisms, encrustations, truncation and signs of bioerosion. Borings are key evidence in investigations of hardground development. The unequivocal identification of borings is done through identification of the crosscutting relationship between the proposed boring and a hard substrate such as lithoclasts and/or shells. However, morphological criteria are difficult to use when trying to identify borings or burrows in a homogeneous substrate. Bioeroded hardgrounds and burrows with a micrite halo/lining are subjects to fracturing and reworking, resulting in accumulations of intraclasts in flat-pebble conglomerates (FPC). The recognition of borings and broken burrows with a halo can be challenging in FPC. Using trace fossils preserved in situ and in FPC in the late Cambrian carbonates of North China, we established a set of criteria for distinguishing borings from burrows with a halo in FPC. Features such as the relative volume of burrows and borings versus the host pebble and the number of traces per pebble, the cross-cutting relationship with laminae of different colour, and the presence of pyrite or glauconite encrustations can all be used for the recognition of borings. However, examination of the crosscutting relationship and encrustation are not sufficient on their own. Our results suggest caution by defining borings in FPC, particularly as synsedimentary deformation of burrows with a halo in the late Cambrian FPC can create structures similar to borings.

ABSTRACT

Received 4 April 2023
Accepted 11 May 2023
Available online 14 June 2023

Keywords:
flat-pebble conglomerates, diagenetic halo, fragmentary burrow, borings

Corresponding author:
Zhifei Zhang
elizf@nwu.edu.cn

Citation:
Hu, Y., Strotz, L. C., Knaust, D., Wang, J., Liang, Y. and Zhang, Z. 2023. Distinguishing borings and burrows in intraclasts. *Estonian Journal of Earth Sciences*, **72**(1), 133. https://doi.org/10.3176/earth.2023.44

14TH ISOS
ESTONIA 2023