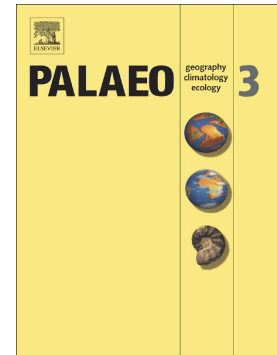


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Possible courtship behaviour of Devonian fish: evidence from large radial trace fossils in northwestern China

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ABSTRACT One kind of mysterious underwater circle observed on the seafloor near southern Amami-Oshima Island in subtropical Japan has attracted widespread attention, but its origin has long been unknown. In recent years, based on successive underwater photography, they were shown to represent the patterned structures constructed by male pufferfishes. Here we present a large radial trace fossil from the Upper Devonian Hongguleleng Formation in western Junggar, Xinjiang, Northwest China. They are circular or near-circular patterned structures consisting of numerous radial grooves and ridges. Based on morphological analysis of these trace fossils and comparison with the modern patterned structures made by pufferfish for courtship, we suggest that this trace fossil may be patterned structures made by male fish in the Devonian to attract females. If true, these structures would be the first reported example of courtship behaviour in the trace fossils of fish, and suggest that animal courtship behaviour has existed for at least 360 million years. These trace fossils provide new material for research on the breeding strategies and sexual selection of Devonian animals, and new insight on the origin and evolution of courtship behaviour.

Keywords: Ethology; Mating; Breeding strategy; Late Devonian; Hongguleleng Formation

1. Introduction

Courtship behaviour is very common in living animals. Typically, to attract a mate, the male will show the female its more developed or colourful body organs or structures, or will perform some complex actions (West, 2009). Among these behaviours, the former type is easier to identify, and evidence of it has even found for ancient animals (cf. Wang et al., 2013; Zheng et al., 2017). However, although complex actions for courtship, as animal behavioural processes, may be

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