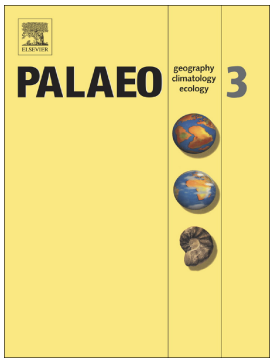

Gypsum growth induced by pyrite oxidation jeopardises the conservation of fossil specimens: An example from the Xiaheyan entomofauna (Late Carboniferous, China)

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Gypsum growth induced by pyrite oxidation jeopardises the conservation of fossil specimens: an example from the Xiaheyan entomofauna (Late Carboniferous, China)

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Abstract

The destruction and damage of fossils in palaeontological collections through pyrite (FeS_2) oxidation is a major and well-known issue. In this paper, we investigate the impact of this reaction on the conservation of Xiaheyan fossil entomofauna (Tupo Formation; Late Carboniferous; Ningxia, China) through three steps. First, we examined and characterised the elemental and mineralogical composition of newly excavated specimens, of museum specimens, and of weathering products at the outcrop (using SEM-EDX, Raman microspectroscopy and XRD). Second, in order to determine the potential reactivity of newly excavated fossils, we performed artificial ageing experiments, a technique recently applied in palaeontology that can offer valuable insights into long-term conservation of fossils. Finally, we designed and applied a protocol aiming at forcing the formation of gypsum outside the fossils so as to preserve the fossil integrity, namely 'crystallisation pits'. Our data demonstrate that the depositional environment at Xiaheyan was rich in sulphur and devoid of oxygen, with perhaps oxygen-rich microenvironments, which led, respectively, to the precipitation of framboidal pyrite and of primary iron oxyhydroxides. The further chemical palaeo-weathering led to an extensive oxidation of pyrite in the outcrop, resulting in the precipitation of secondary iron oxyhydroxides, and of jarosite and gypsum, both sulphates. The low abundance of iron oxyhydroxides and the poor diversity of sulphates, compared to analogous localities, indicate a distinct weathering scenario, with a persistence of acidic water and an extensive leaching leading to the maintenance of only insoluble sulphates. Despite the extensive *in situ* pyrite oxidation,