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The Outstanding Geology and Geoheritage of The Niah Caves and Karst Area

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ABSTRACT

This paper provides an overview of current information (including research results since 2011) on outstanding geological features of Niah karst region and caves, to support nomination of the property for World Heritage status. The geomorphology visible today is due to geological processes affecting the predominantly Miocene Subis Limestone since uplift: dissolution in vadose and phreatic zones, sediment deposition and removal, mechanical breakdown, speleothem formation and surface weathering. The caves developed at several levels in tropical tower karst (fenglin), with vertical cliffs, swamp notches and a semi-flooded epiphreatic cave network, evidence of ongoing karstification. The walls of relict Traders' Cave have anastomosing ceiling grooves associated with wall notches indicating that it was partially filled with sediment and flow from large streams several times during its formation, prior to more recent mechanical breakdown. The numerous large and complex caves have high aesthetic value, with ceiling skylights and impressive entrances connecting to the surrounding forest. They contain speleothems (stalagmites and stalactites) of types rarely found elsewhere in the world. The Painted Cave holds one of the world's largest cluster of unique crayback-like stalagmites, which are influenced by constructive activity of calcifying cyanobacteria and only form under limited environmental conditions of specific light levels and wind. Microbial activity can also be erosive and is likely responsible for pancake pinnacles and rare photokarren, reported here in Niah for the first time. In addition to their undisputed archaeological, cultural, ecosystems and conservation values, the Niah caves and karst region also have many interesting geological and geomorphological features, some of which are rare and hence have geoheritage value.

Keywords: Niah, karst, fenglin, crayback, pinnacle, photokarren

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INTRODUCTION

UNESCO World Heritage Karst Properties

Karst is a general term that denotes specific landscapes and particular features that develop, both above and below ground, in carbonate rocks (such as limestones) and more rarely in certain other rocks that are soluble under the action of slightly acidic meteoric water and/or aggressive groundwater (Jones & White, 2012). Limestones will nearly always contain caves and other karst features that form predominantly by chemical weathering (dissolution). The complexity and the significance of the caves and karst features in a region will depend on the specific characteristics of the host rock, the regional geologic history, including history of uplift and tectonic deformation, past and present climates and surface drainage from surrounding non-karst areas.

Among the current total of 1154 UNESCO World Heritage properties, around 50 are related directly to karst and/or caves, and the karst features and landscapes may be the main criteria for inclusion in the list (Hamilton-Smith, 2006, 2007; Williams, 2008). For these, they usually represent criterion (vii), having superlative natural phenomenon, natural beauty and aesthetic value, and/or they represent criterion (viii) as representing significant on-going geological processes in development of landforms and significant geomorphic features. About half of the 50 properties have karst with Outstanding Universal Value (Williams, 2008). For example:

Criterion (vii): The Tsingy of Bemaraha in Madagascar “represents rare or eminently remarkable geological phenomena and of exceptional beauty”, the forest of sharp limestone pinnacles (UNESCO, 2022) (whc.unesco.org/en/list/494). The property also represents criterion (x).

Criterion (viii): Phong Nha-Ke Bang National Park in Viet Nam with numerous major and complex caves, of which the Son Doong Cave could contain “the world’s largest cave passage in terms of diameter and continuity”. The distinctive karst topography and “caves demonstrate a sequence of events” and hence “is of great importance in our understanding of history of the region” (UNESCO, 2022) (whc.unesco.org/en/list/951). The property also represents criteria (ix) and (x).