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Title: Cave guano: a new source of palaeoenvironmental information

Abstract: Cave guano refers to C,N,S,P-rich organic material excreted by the bats and birds (swiftlets) that roost in many tropical caves. Cave guano should not be confused with the lithified phosphate deposits accumulated in the open on tropical islands. Some large caves have been occupied by millions of individuals over extended periods of time and deposits of well-stratified guano have built up to depths of several metres. Thick deposits are known to exist in Niah Cave, Sarawak and Gomontong Cave, Sabah. Early Geological Survey reports suggested up to 10 metres of stratified guano existed in some caves in peninsular Malaysia, though field visits have shown that these deposits have now been largely mined for fertilizer. Caves that are known to contain large bat/bird populations are widely distributed in southeast Asia from the Andaman Islands, through Myanmar, Indochina, Thailand, Malaysia, Indonesia, Papua New Guinea and the Philippines. Such deposits of guano represent an, as yet, completely untapped source of palaeoenvironmental information on glacial-interglacial timescales from the tropics. Preliminary work on a 7-metre sequence of stratified guano from Niah Cave suggests that it contains a rich paleoenvironmental record that spans the last 100,000 years or more, and is amenable to carbon dating. Pollen, carbon-isotope, carbon-dating and XRF analysis of the deposits have provided a record of vegetation change and dust flux with high stratigraphic integrity. The carbon-isotope composition of the guano from the Last Glacial Maximum is ~3‰ higher than before and after, suggesting either the presence of C4 (grass) vegetation in the area surrounding the cave, or water-stressed forest, confirmed by the presence of grass pollen. The results suggest that the Niah Cave area was substantially drier than present during the Last Glacial Maximum, a conclusion at odds with the conventional interpretation that northeast Borneo was a major refugial area at that time. Anomalies in both the carbon-isotope composition of the guano and dust flux in the upper part of the record appear to correlate with the Younger Dryas, and the carbon-isotope record further suggests that rainfall had not increased sufficiently by the beginning of the Holocene to allow the development of moist tropical forest. Significant questions remain regarding the effect of diagenesis and bioturbation on guano. Nevertheless, the widespread existence of thick, ancient guano deposits in a region for which very little palaeo-environmental information exists, suggests that major advances in understanding the paleoenvironmental history of Southeast Asia can be made through locating other deposits similar to those of Niah Cave.

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