

Thesis Abstracts

Author: Lee Arnold
Thesis Title: Optical dating and computer modelling of arroyo epicycles in the American southwest
Grade: D.Phil.
Date: May 2006
Supervisors: Richard Bailey, Greg Tucker, Simon Armitage
Address: St.Peter's College, University of Oxford

The origin of arroyo cut-fill epicycles has been the subject of debate for over a century in the American southwest. Whilst it is now acknowledged that a variety of causal factors can control arroyo dynamics, there are still many outstanding research issues concerning the fundamental cause-effect relationships responsible for arroyo epicycles. This thesis aims to develop a better quantitative understanding of arroyo cut-fill dynamics and causality using a combination of optically stimulated luminescence (OSL) dating and computer modelling. The results of the chronological and modelling analyses are combined together to provide detailed reconstructions of alluvial histories within a large southern Californian arroyo system (the Cuyama River Valley) and four smaller arroyo systems located across southeastern Colorado.

An integral part of this research involves testing and demonstrating the suitability of single-grain/single-aliquot quartz OSL dating techniques in an ephemeral fluvial context. A series of simulated fluvial dose distributions and known-age empirical samples are analysed to formulate objective strategies for identifying and characterising heterogeneously bleached samples. These datasets are subsequently used to develop statistical decision procedures capable of informing the selection of appropriate 'age models' for burial dose estimation.

Computer modelling simulations conducted on a small, semi-arid ephemeral catchment demonstrate the potential for arroyo cut-fill epicycle occurrence in the absence of any precursory external climatic forcing. These modelling results provide process-based evidence for the existence of intrinsic arroyo control mechanisms and support the hypothesis that channel cutting and filling is a fundamental, natural process in ephemeral catchments. A series of additional modelling investigations are undertaken to

systematically evaluate how ephemeral basins of the American southwest might have responded to climatic events during the late Quaternary. These sensitivity tests demonstrate that it is too simplistic to conceptualise arroyo epicycles in terms of mean precipitation shifts; the key to understanding arroyo behaviour from a climatic perspective lies with a more complete consideration of individual climatic parameters such as rainfall intensity, frequency, duration and seasonality.

The complex relationship between climate change and arroyo formation is particularly evident in the reconstructed alluvial histories of the southeastern Colorado arroyo systems. In the Cuyama River Valley, climate appears to have controlled arroyo dynamics both directly and indirectly through a complex interplay with, and conditioning of, hydrology, hillslope processes and vegetation dynamics.

Author: George S. Polymeris
Thesis Title: Low dose detection by thermoluminescence and optically stimulated luminescence using minerals as time integrating luminescence dosimeters
Grade: PhD
Date: June 2006
Supervisors: George Kitis
Address: Aristotle University of Thessaloniki, Physics Department, Nuclear Physics Laboratory, GR – 54124, Thessaloniki, Greece
 &
 Cultural and Educational Technology Institute (C.E.T.I.), Research Centre "ATHENA", Tsimiski 58, GR – 67100, Xanthi, Greece.

The present thesis investigates whether certain geological natural minerals, such as quartz (SiO₂) and/or natural calcium fluoride (CaF₂:N), could be effectively used as Time – Integrating Luminescence Detectors for setting bounds on interaction's strength

of dark matter particles with ordinary matter. The limitations imposed by the background of cosmic radiation as well as environmental radioactivity are investigated, and initial limits for the interaction strengths with ordinary matter, and the mass of Weakly Interacting Massive Particles (WIMPs) and axions are derived. The Optically Stimulated Luminescence (OSL) properties of the natural calcium fluoride are studied, indicating it as the most suitable phosphor, for the proposed method, mainly due to its extremely low detectable dose threshold. The effective application of the retrospective dosimetry's working principle in deep sea sediments is also indicated, using a deep sea sediment core collected from the operational site of the NESTOR experiment, 14 km off the South – West Coast of Peloponnesus, at a depth of almost 4 km. Therefore, the use of quartz from deep sea sediments is proposed as well, mainly due to the shielding provided by water from cosmic rays. Finally, the possibility of using the pre-dose technique protocol in the OSL signal is studied by taking advantage of the sensitization of its second component.

Author: Kira Westaway
Thesis Title: Reconstructing the Quaternary landscape evolution and climate history of western Flores: an environmental and chronological context for an archaeological site
Grade: PhD.
Date: September 2006
Supervisors: Richard Roberts
Address: University of Wollongong, New South Wales, Australia

The recent discovery of a late-surviving new human species, *Homo floresiensis*, in western Flores has accentuated our lack of understanding of the history of the genus *Homo* in Asia and of the environmental challenges that may have influenced these hominins. Western Flores contains a wealth of archaeological and palaeoanthropological material with far-reaching implications for human evolution and for Indonesian, Australian and world archaeology. But the interpretation of this evidence has been hindered by a limited Quaternary context and age control for complex stratigraphies in a region of great geological instability and widespread environmental change.

Liang Bua in western Flores is a key site in the Indonesian archaeological record, providing evidence

of cave occupation by *Homo floresiensis* and *Homo sapiens*, and human evolution and dispersal on the eastern side of Wallace's Line. In this study, archaeologically-relevant information has been gleaned from an interdisciplinary approach to the analysis of this site, and has established the timing of key events, such as the first exposure of the cave and the nature of, and influences on, human occupation of the cave. This approach incorporated studies of landscape evolution, river terrace and cave development, sedimentology of cave sediments, palaeoclimate signals in speleothems, and a dating strategy utilising novel approaches to luminescence dating.

The research reported here provides a chronological and environmental backdrop to the human occupation of Liang Bua. A maximum age of cave occupation is shown to correspond to the time of cave exposure (~190 ka), which also represents a minimum age for the human habitation of the area. In addition, this study has established an age range for the occupation of the cave by *Homo floresiensis* (95–11 ka), the time of the most intensive phases of occupation (74–61 and 17–11 ka), the depositional age of the holotype skeleton (36–14 ka), and the age of the oldest human skeletal remains found on Flores (95–74 ka). Through the integration of techniques, a framework for terrace development and landscape evolution has been developed to establish the Quaternary setting in which the cave was formed and evolved. These techniques have also defined a sequence of geomorphological and sedimentological changes in the cave, enabling the reconstruction of the occupational environment. At least two zones of occupation have been identified: a zone established ~74–61 ka, and a later zone established ~18 ka.

The environmental backdrop for the arrival and dispersal of humans throughout Indonesia has been established via a palaeoclimatic and palaeoenvironmental analysis of speleothem records. These records contain evidence of multiple wet phases (110–98, 82–65, 49–39 and 17–5 ka) and a flourishing fauna. The timing of these wet phases correlate with evidence for channel and flowstone formation, episodic erosion events, and the most intensive periods of occupation in the cave. There is also evidence for a prolonged period of reduced rainfall (36–17 ka) in an organic-poor environment, the timing of which correlates with evidence of reduced erosion, pooling and less intense occupation. These correlations suggest that the occupational success of *Homo floresiensis* in this area was related to the contemporaneous environmental conditions, which, combined with the evidence for at least two volcanic events (one of which may have forced

human migration), establish a link between hominids and their environment.

The results of this research indicate the value of using an interdisciplinary approach to investigate and interpret archaeological sites in Southeast Asia. By providing an environmental and chronological context for important archaeological finds, we can develop a better understanding of the prehistory of *Homo* in Asia.

