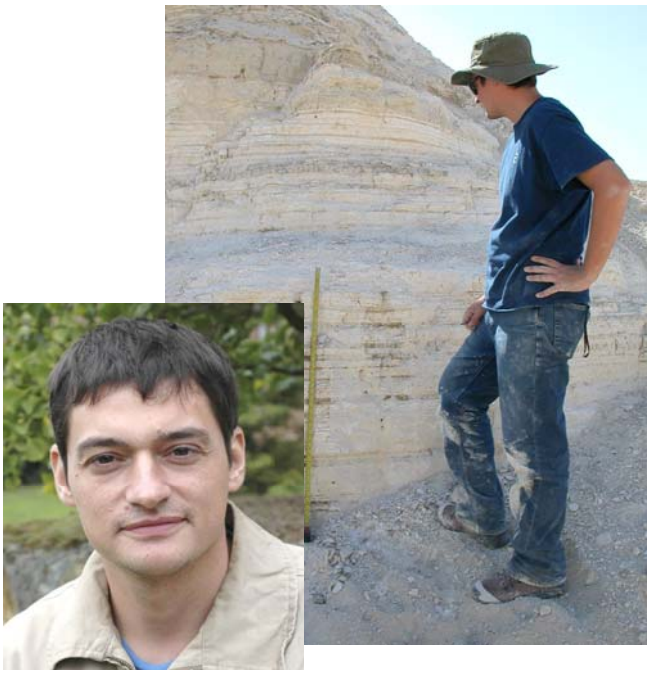
Palaeoenvironments

4.1

Aims and overview

The WLC Palaeoenvironments sub-project is led by Dr Stuart Black and aims to reconstruct the palaeoenvironmental history of the Jordan Valley as a means to provide data to evaluate the outputs from the other sub-projects. The first year has involved two key tasks: a review of existing data and interpretations of palaeoclimates in the Levant and eastern Mediterranean and fieldwork within the Jordan Valley. Dr Stuart Robinson (SAR) was appointed to the position of research fellow for three years in February 2005. He quickly assimilated the necessary information and literature to write a review of the palaeoclimates of the region (see below) and conduct several field work sessions. However, Dr Robinson resigned his position in September to take up a Royal Society University Research Fellowship at University College London. A replacement will be appointed early in 2006. Richard Fitton was awarded a PhD studentship to undertake research on the palaeoclimatic reconstruction of the Lake Lisan sequence. He will be supported by Professor Abdulkader M. Abed, University of Jordan, with whom the project is developing further collaborative research.



Richard Fitton has been awarded a PhD studentship to undertake reconstruction of the Lake Lisan sequence. He graduated in geology from the University of Toronto and joined the WLC project in October 2005. Almost immediately, he joined the field visit of Stuart Black and Bruce Sellwood to the Jordan valley and is seen here inspecting the finely stratified base of the Lisan sequence.

4.2

Collation of background data and submission of major review on palaeoclimate changes.

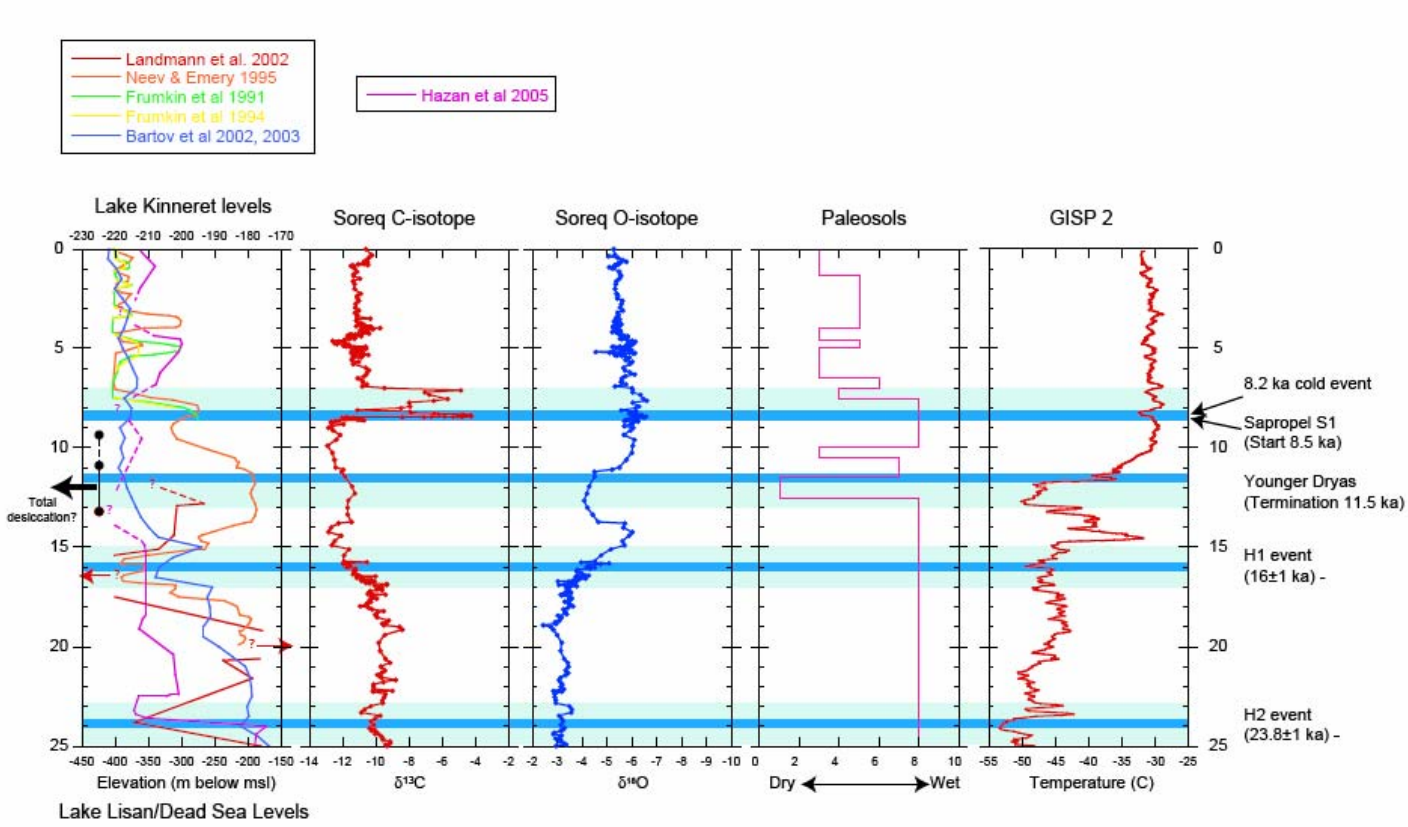
This sub-project has assembled a major database from a wide range of published sources and in so doing discovered significant discrepancies in the way that background information has been used in the past, particularly age-dating. We have standardized the age dates. This has clarified the palaeoclimatic event stratigraphy. A major review of the palaeoclimate of the region has been cast as a research paper which was submitted to a leading earth sciences journal, *Quaternary Science Revie*ws. This paper has been accepted for publication, subject to minor amendments. The reviewers of this manuscript (2 anonymous), both stated how important this piece of work would be to the study of palaeoclimates:

“Of all the regions of the world where human culture and climate have co-evolved during the Quaternary, the Levant is unquestionably one of the most important. Not surprisingly, this has prompted periodic reviews in the literature of the evidence for palaeoenvironmental change. So, what is the case for publishing another such synthesis? Firstly – and most obviously – to bring matters up to date. Secondly, to bring this to a wider, English-speaking audience in a main-line international journal. …

Thirdly, the authors here bring a global and multi-disciplinary perspective rather than a local one on the E. Mediterranean record" Reviewer A.

"The authors are to be congratulated on what is generally a very well-written piece of work, reaching sound conclusions. The attempt to erect a regional climatostratigraphy is definitely worthwhile and would be of interest to readers of QSR…" Reviewer B.

This review has significantly advanced our understanding of the present situation regarding palaeoclimate research in the region and is providing a knowledge base for all the project teams at Reading.



A key task for the WLC Palaeoenvironments sub-project during the first year has been to acquire, critically assess and then collate the existing data for the environmental history of the study region, and in particular the southern Levant. There are numerous sources of data, including ice cores and lake sediments, which have been analysed using a diverse range of techniques. Led by Stuart Robinson, the team reviewed this evidence for the time period 25,000-5000 years ago and have produced a major paper for publication in Quaternary Science Reviews from which this illustration is taken: **Robinson, S.A., Black, S., Sellwood, B. W. and Valdes, P.J. (In press). A review of palaeoclimates in the Levant and Eastern Mediterranean from 25,000 to 5,000 years BP: setting the environmental background for the evolution of human civilization**. *Quaternary Science Reviews.*

4.3

Collation of background data and submission of major review on palaeoclimate changes.

Fieldwork was conducted during visits to the Jordan Valley in May by Dr Black and Dr Robinson and in October, when they were joined by Richard Fitton. This involved visiting numerous of the key archaeological, geological, hydrological and geomophological sites for the project. Samples were collected, and are now undergoing analysis, from Pleistocene and Holocene geological sequences ranging through more than 20,000 years from the Present. Important observations to date are:

1) The Dead Sea travertine sequences cropping out between -350 and -178 m below sea level are extremely extensive, and represent large bodies of spring water discharging into the Jordan Valley that have not been previously recorded. Comparison with the Israeli literature suggests these sequences are < 14000 years B.P. (given their height, in relation to the older Lake Lisan, a water body that rose to -170 m below sea level from 14-64 kyrs B.P.). The extent of these thick (+10 m) travertine sequences indicates they were deposited rapidly, preserving a very high resolution sequence of climatic events;

The geological deposits referred to as the Lake Lisan sequence in the Jordan Valley. These will be sampled by the Palaeoenvironments team in 2006.

The fieldwork by the Palaeoenvironments team in the Jordan Valley has located an unexpected number of travertine deposits that have been formed by spring water flowing into the valley, often in locations where the springs are no longer active. This example is close to Ma'an in the southern part of the valley. Although the project has not yet dated the deposits, it seems likely that they represent a substantial part of the Holocene period and will provide an invaluable source of evidence about the extent and nature of water availability.

2) Several Neolithic archaeological sites (e.g. Beidha and WF16) have sequences of materials preserved near to the settlements and we have made observations, and collected material, generating significant climatic data relating to the origin of settlements and the onset of farming;

3) Historical sites such as the Roman city of Jaresh, the Marmaluke sugar Mill at Safi, the Roman aqueduct in Wadi Faynan and at the Nabatean city of Petra, have preserved carbonate deposits on water channels, mills, and reservoirs which are well preserved and will provide information on water availability, sources and compositions, for these cities.

The Neolithic site of Beidha in the southern reaches of the Jordan Valley is one of the most important prehistoric sites in the region, having been extensively excavated by Kirkbride and with an important Natufian cultural horizon underlying that of the Neolithic. This site will be the subject of a hydrological study later in the project. During the first year the Palaeoenvironments team have been sampling deposits located between the Natufian and the Neolithic occupations which may provide critical data about the environment and climate during this hiatus in occupation. They also located previously unknown travertine deposits indicating the presence of spring in the vicinity of the site, samples of which are now being dated and analysed as to the chemical composition of the water.

A water pipe coming from the baths at the Roman site of Jerash containing well-preserved carbonate deposits that will be sampled for information about the character of the Roman water supply.

4.4 Research priorities for 2006

The new PDRF, Professor Sellwood and Dr Black will drill through the Dead Sea travertine sequences, collecting samples from known heights. These samples will be dated (using U-series and ^{14}C), sectioned in the laboratory and micro-drilled to extract carbonate from each (annual) layer of precipitation and analysed for C and O isotopes. These data will permit the reconstruction of climate during the selected time periods - potentially on an annual basis.

Richard Fitton, Professor Sellwood and Dr Black will sample the Lisan sequence in detail at localities along the Jordan Valley, in conjunction with Prof. Abdulkader M. Abed (University of Jordan), and return these samples to the UK for analysis. Samples will then be analysed by portable XRF and X-radiography prior to sampling for high resolution stable isotope analyses (C, O and H). Samples will also be prepared for organic H and O analysis at Bristol University.

Dr Black will sample further sequences in Wadi Faynan, Beidha, Jerash, Jawa to complete the sequences already collected. These materials will be dated (using U-series and ^{14}C) in the first instance to establish an absolute chronology prior to sampling for further analysis).