UK IMAGES 2002 activity report.

This report for the UK IMAGES involvement consists of a compilation of summary statements as submitted by 22-01-2003, by UK researchers that are involved in IMAGES-related research. No fixed format was followed to allow individual researchers to emphasise those aspects they consider most relevant. Additions based on late entries will be made as they are submitted to the UK IMAGES representative.

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JAMES SCOURSE, University of Wales, Bangor

SEQUENCING OCEAN-ICE-CLIMATE INTERACTION IN THE NE ATLANTIC

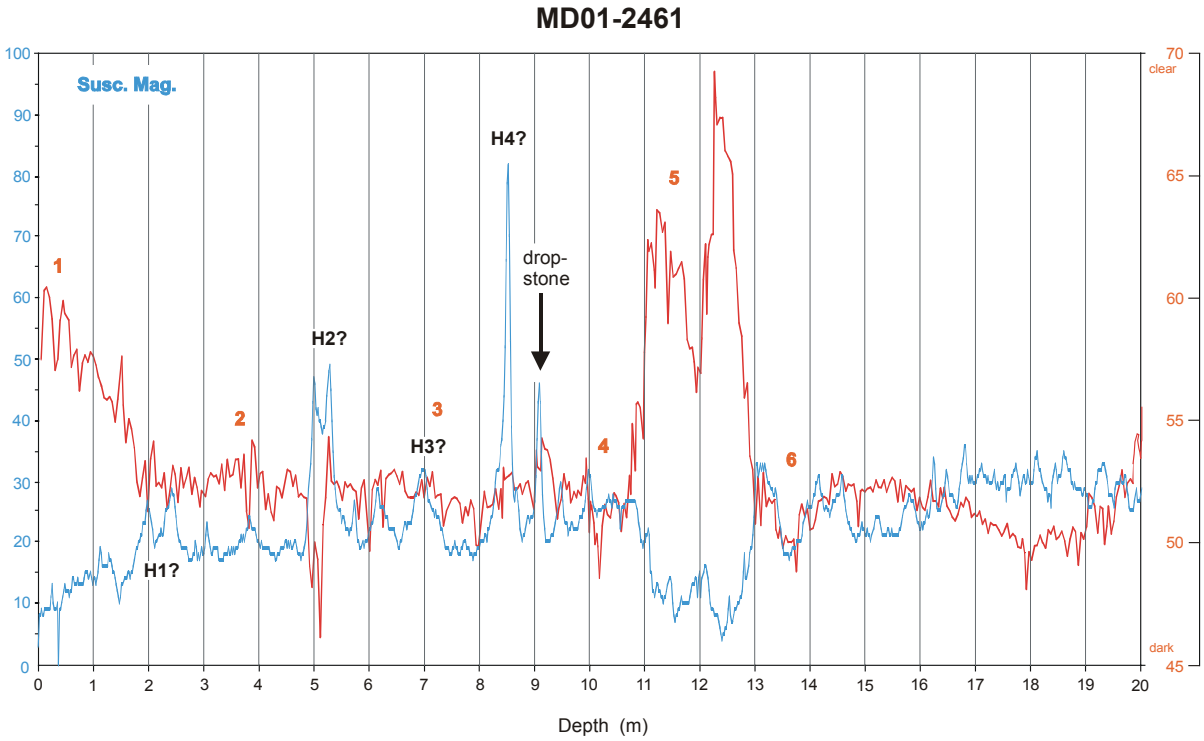
During 2001 James Scourse (Bangor), Ian Hall (Cardiff) and Francis Grousset (Bordeaux) were awarded funds by The Royal Society to acquire a CALYPSO core from the Porcupine Seabight. The aim of this project was to develop our understanding of the causes of phasing between IRD fluxes from the British Ice Sheet and the Laurentide Ice Sheet along the British margin and specifically to test whether the 'precursor events' identified by Scourse *et al*. (EPSL, 182, 1870195) are indeed genetically linked to Heinrich events or whether they are part of the pervasive 1.5 kyr cycle identified in the North Atlantic.

Core MD01-2461 was recovered from the western flank of the Porcupine Seabight during cruise MD123/Geosciences during September 2001. The core was subject to multiple non-invasive analyses onboard *Marion Dufresne* during the cruise, including digital photography, colour, reflectance, magnetic susceptibility and gamma ray log in addition to visual description. These data, in particular the magnetic susceptibility (MS) and reflectance records, enable preliminary assessment of the continuity and length of the record recovered (see Figure 1). Our prime aim was to penetrate a high-resolution seismically laminated sequence characterised by minimal post-depositional disturbance which included a well-developed ice-rafted detritus (IRD), and specifically Heinrich layer, record. A pre-coring 3.5kHz geophysical survey enabled selection of an optimum core target site. Preliminary assessment of the 20 m long core indicates that our aim has been achieved. The record extends to marine isotope stage (MIS) 6 with a mean sedimentation rate of 1m ka^{-1}. MIS 5 and 1 are particularly clear, consisting of sections of foram-coccolith ooze with high reflectance and low MS. The remaining sections consist of hemipelagic muds with higher lithic and lower carbonate content. Two Heinrich (H) layers are prominent in the MS records, probably H2 and H4. The character of MIS 6 appears quite different to MIS 2-4 at this site, with much reduced IRD content and beautifully distinct laminae.

Partly on the basis of the successful recovery of this core, we applied to NERC for funding for a standard research grant during 2002 and on 29/04/2002 NERC offered us (Scourse, Hall, with Zahn (Cardiff), Austin (St Andrews) and McCave (Cambridge), with Grousset as overseas collaborator) an award of £318,187.18, with additional £70,000 for tied studentships and £408,000 for shiptime on RRS Discovery, making a total of £796k. This grant started on 01/10/02 and will end on 30/09/06. The acquisition of the core has also resulted in the award of a NERC quota Ph.D. studentship at Cardiff University (see above). The stage 6 laminated sediments

are now the subject of a Ph.D. study based at Bordeaux under the supervision of Dr Frédérique Eynaud.

The continuity, length and resolution of the MD01-2461 record will enable us to undertake very detailed analyses (IRD species and provenance, benthic and planktonic foraminiferal $\delta^{18}O$ and $\delta^{13}C$ stable isotopes) which will help determine the phasing of BIS and LIS IRD input and the relations between the IRD record and thermohaline intensity in the North Atlantic. This core is therefore likely to yield important evidence on ice-ocean-climate interaction in this key region which will be of significance in understanding natural climate variability.



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CAROL PUDSEY, British Antarctic Survey, Cambridge

2 PhD students involved:

Ian J Hawkes (CASE student, Univ of Lancaster and BAS, supervisors Dr M Hounslow and Dr C J Pudsey) has conducted a detailed study of environmental magnetism in cores from the Antarctic Peninsula continental rise. Similarity in magnetic properties among interglacial (stages 1 and 5) sediments on four contourite drifts suggests alongslope transport by bottom currents. Glacial sediments (stages 2-4) are dissimilar on different drifts. It is likely these sediments were derived mainly from downslope mass flows and only locally redistributed by weak bottom currents. The study area is well south of the Antarctic Circumpolar Current and the bottom water originates in the Weddell Sea. These results agree with earlier UK and German studies which suggested slower Weddell Gyre circulation during glacial periods.

Report for Clare Allen to be added.

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CHRIS GERMAN, Southampton Oceanography Centre, Southampton

During 2002 Germain Bayon completed his PhD at SOC using IMAGES cores from the NAUSICAA cruise to the SE Atlantic (SW African Margin) in 1996. During the course of the year he had one peer-reviewed article published in Chemical Geology and another accepted for publication in G^3.

G.Bayon, **C.R.German**, R.M.Boella, J.A.Milton, R.N.Taylor and R.W.Nesbitt. An improved method for extracting marine sediment fractions and its application to Sr and Nd isotopic analysis. Chem. Geol. 187, 179-199, 2002.

G.Bayon, **C.R.German**, R.W.Nesbitt, P.Bertrand & R.R.Schneider. Increased input of Circumpolar Deep Water-borne detritus to the glacial SE Atlantic Ocean. Geochem. Geophys. Geosystems, *in press*

PhD Title: "An investigation into Nd and Sr isotopes in marine sediments and their application to paleoceanography. (July 2002, 212pp)

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BILL AUSTIN, University of St. Andrews, St. Andrews, Scotland

Lindsay Wilson (Ph.D. student) and Bill Austin continue to work on two IMAGES cores: MD95-2006 and MD95-2007 from the Hebridean margin, NW Scotland. A recent NERC award "sequencing ocean-ice-climate interaction in the North East Atlantic" will allow continued work on these cores and included a NERC-funded Ph.D. studentship (start date 1 October, 2003; closing date 1 March, 2003; see http://www.st-andrews.ac.uk/academic/gg/schoolpage.html). Bill Austin and Niels Norgaard-Pedersen recently completed the XRF core-logging (at the ODP core repositor, Bremen) of IMAGES core MD01-2462 from the Goban Spur - collaborative work with PI's Ian Hall (Cardiff) and James Scourse (Bangor). Bill Austin attended the IMAGES "Heinrich Event" workshop at INSTAAR, Boulder in December 2002 and presented a paper on "the age and chronostratigraphic significance of North Atlantic Ash Zone II".

Recently Published work on IMAGES cores:

Kroon, D., Shimmield, G., Austin, W.E.N., Derrick, S., Knutz, P., and Shimmield, T. 2000. Century- to millennial-scale sedimentological-geochemical records of glacial-Holocene sediment
variations from the Barra Fan (NE Atlantic). Journal of the Geological Society, Vol. 157, 643-653.

Knutz, P.C., Austin, W.E.N., and Jones, E.J.W. 2001. Millennial-scale depositional cycles related to British Ice Sheet variability and North Atlantic paleocirculation since 45 kyr B.P., Barra Fan, U.K. margin. Paleoceanography, 16, 53-64.

Wilson, L.J., Austin, W.E.N. and Jansen, E. 2002 . The last British ice sheet: growth, maximum extent and deglaciation. Polar Research, 21(2),243-250
Knutz, P.C., Jones, E.J.W., Austin, W.E.N., and van Weering, T.C.E. 2002. Glacimarine slope sedimentation, contourite drifts and bottom current pathways on the Barra Fan, UK North Atlantic margin. Marine Geology, 188, 129-146.
Wilson, L.J. and Austin, W.E.N. 2003. Millennial and sub-millennial-scale variability in sediment colour from the Barra Fan, NW Scotland: implications for British ice sheet dynamics. In: Dowdeswell, J.A. and O'Cofaigh, C. (eds.) Glacier-Influenced Sedimentation on High-Latitude Continental Margins. Geological Society London, Special Publication, 203, 349-365.

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NICK SHACKLETON, University of Cambridge, Cambridge

The Godwin Laboratory (Cambridge) group is working on material from three IMAGES cruises on the Iberian Margin (MD95, MD99 and MD01). The major new activity is on cores collected in 2001 for which the coring was funded by EC in the POP (Pole-Ocean-Pole) project but cores that were collected partly with NERC support on MD95 and MD99 continue to be exceptionally valuable, highlighting the long-term value of well designed IMAGES coring. De Abreu is working on a high-resolution record of Marine Isotope Stage 11 (MD01-2443). Heather Cheshire (MPhil student) did a pollen study in MIS6 to MIS5 transition (MD01-2442). Tzedakis has begun a pollen study of MIS11 (MD01-2443). Skinner (PhD student) has done very extensive work on Mg/Ca thermometry and other aspects using MD99-2334 (collected using Professor I.N. McCave's kasten corer on IMAGES99). Shackleton is working on MD01 cores replicated and enhancing details in MIS3 that were first detected by him in MD95-2042. De Abreu has extended work on MIS6 in MD95-2040 and completed a stable isotope record for MD95-2041. Vautravers has worked on MIS5 and other intervals in several MD01 cores. Cacho has done extensive Mg/Ca paleothermometry on MD95-2043 to compliment her published alkenone work on this core.

Cacho, I., Grimalt, J.O., Canals, M. (2002) Response of the western Mediterranean Sea to the rapid climatic variability that occurred during the last 50,000 years: A molecular biomarker approach. *Journal of Marine Systems*, **33-34**, 253-272
Cacho, I., Sierro, F., Shackleton, N.J., Elderfield, H., Grimalt, J. (2002) Reconstructing Alboran Sea hydrography during the last organic rich layer formation, *Geochimica et Cosmochimica Acta*, **66**, A115
Cheshire, H. (2002) The Marine Isotope Stage 6/Substage 5e Transition in a Core from the Iberian Margin. Dissertation for MPhil. Degree in Quaternary Science
de Abreu, L., Schönfeld, J., Abrantes, F.F.G., Shackleton, N.J., Hall, M.A., Voelker, A. (2002) Sub Millennial-Scale Climate Variability off the Western Iberian Margin During the Penultimate Glacial Period (MIS 6). *EOS Transactions, American Geophysical Union Abstracts, Fall Meeting 2002*, **83**, PP21B-0307
Marchal, O., Cacho, I., Stocker, T. F., Grimalt, J. O., Calvo, E., Martrat, B., Shackleton, N.J., Vautravers, M., Cortijo, E., van Kreveld, S., Andersson, C.,

Koç, N., Chapman, M.R., Sbaffi, L., Duplessy, J-C., Sarthein, M., Turon, J-L., Duprat, J., Jansen, E. (2002) Apparent long-term cooling of the sea surface in the Northeast Atlantic and Mediterranean during the holocene. *Quaternary Science Reviews,* **21**, 455-483

Moreno, E., Thouveny, N., Delanghe, D., McCave, I.N., Shackleton, N.J. (2002) Climatic and oceanographic changes in the Northest Atlantic reflected by magnetic properties of sediments deposited on the Portuguese Margin during the last 340 ka. *Earth and Planetary Science Letters*, **202**, 465/480

Sánchez Goñi, M.F., Cacho, I., Turon, J.-L., Guiot, J., Sierro, F.J., Peypouquet, J.-P., Grimalt, J., Shackleton, N.J. (2002) Synchroneity between marine and terrestrial responses to millennial scale climatic variability during the last glacial period in the Mediterranean region. *Climate Dynamics*, **19**, 95-105

Shackleton, N.J., Chapman, M., Sánchez-Goñi, M.F., Pailler, D. & Lancelot, Y. (2002) The Classic Marine Isotope Substage 5e. *Quaternary Research*, **58**, 14-16

Submitted and in press

de Abreu, L., Shackleton, N.J., Schönfeld, J., Hall, M.A., Chapman, M. (submitted 2002) Millenial-scale oceanic climate variability off the Western Iberian margin during the last two glacial periods. *Marine Geology*

Pérez,-Folgado, M., Sierro, F.J., Flores, J.A., Cacho, I., Grimalt, J.O., Zahn, R., Shackleton, N. (submitted 2002) Western Mediterranean planktic foraminifera events and millennial climatic variability during the last 70 kiloyears. *Marine Micropaleontology*

Shackleton, N.J., Sánchez-Goñi, M.F., Pailler, D. & Lancelot, Y. (In Press 2002) Marine Isotope Substage 5e and the Eemian Interglacial. *Global and Planetary Change*

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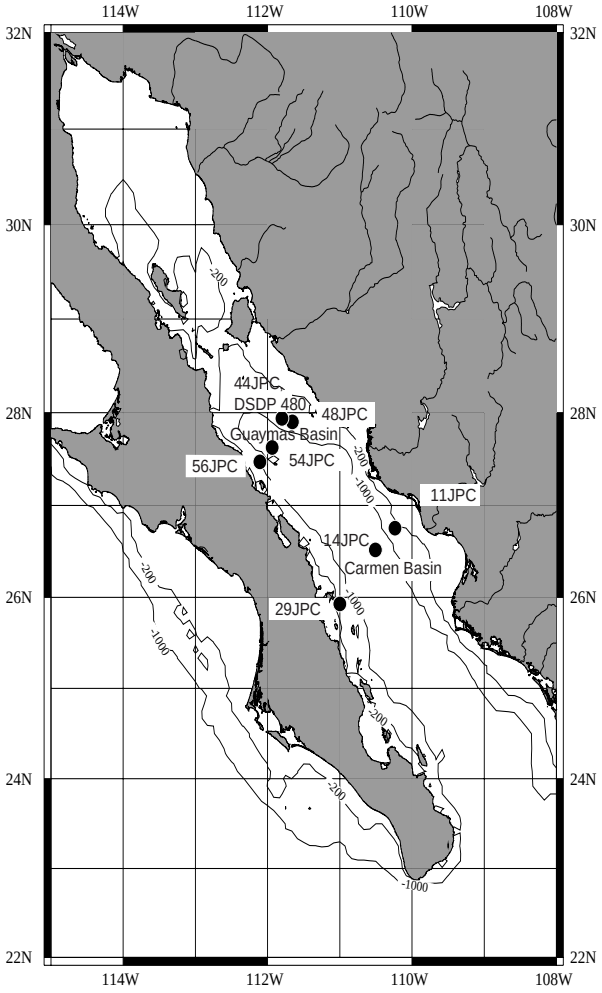
JUERGEN THUROW, University College London, London

We successfully cored 5 cores at 3 localities (JPC44,48,56) in the Guaymas Basin (only one Kastencore less than planned!) - details further down. Large parts of the cores are laminated with abundant diatom mats in the younger parts but I don't know yet the stratigraphic extent of the cores and I have not been able to correlate eastern and western part directly using shipboard reflectance data (due to changing carbonate content?). There is also gas expansion but in most cases the sediment is intact and we can simply ignore the voids. As soon as the detailed core photographs become available, I will be able to correlate all cores, see if sedimentation rates changed and if we have reached stage 5 in any of the cores. Most of the shipboard data including photographs etc. will be in the public domain, e.g. http://images.pclab.ifg.uni-kiel.de/HOME.html

Details of CALYPSO cores (sediment is usually diatom clay with varying carbonate content):



Eastern Guaymas Basin

Locality 1 (DSDP Site 480)
Kastencore 5.6m with sediment/water interface (topmost part mixed)
Calypso Core MD 02-2513 (Station 20, DSDP Site 480; Latitude : 27° 54. 29N ; Longitude :111° 40. 25W ; 642m water depth)
Sediment: 55 m, some voids (gas expansion, holes drilled in liner but probably very little sediment lost)
Locality 2 (near locality 1)
Calypso Core MD 02-2512 (Station 19, Guayamas 1 ; Latitude : 27° 56. 07N ; Longitude : 111° 46. 45W; 477m water depth), approx. 45m sediment (not much gas expansion)

Western Guaymas Basin

Locality 1 (near JPC56, we had to move because JPC56 has apparently less than 40m of sediment cover)
Kastencore 5.6m with sediment/water interface (topmost part mixed)

World record Calypso Core MD 02-2512 (Station 21; Latitude : 27° 29. 01N ; Longitude : 12° 04. 46W ; 881m water depth) (gas expansion but probably not much sediment lost), 65m of sediment
We also took a core in the Carmen Basin (will be stored at Cerege) but the quality of the core is inferior (Latitude 26° 16. 12N ; Longitude : 109° 56. 66W ; 613m water depth).

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GRANT BIGG, University of East Anglia, Norwich

Multi-millennial ocean and coupled ocean-atmosphere model runs were completed and published, showing ability for rapid change in North Atlantic meridional overturning, and potential for feedback with a similarly, but preceding, rapidly changing the Mediterranean overturning system (Bigg, G. R., and M. R. Wadley, 2001, Millennial changes in the oceans: an ocean modeller's viewpoint, J. Quater. Sci., 16, 309-319.)

Iceberg fluxes into the Northern hemisphere glacial oceans were constructed from run-off distribution from two different palaeoclimate models, with significantly different ice sheet topography. In both cases less flux through Hudson Strait was reconstructed than expected, and more output to the Arctic (Bigg, G. R., and M. R. Wadley, 2001, The origin and flux of icebergs into the Last Glacial Maximum Northern Hemisphere Oceans, J. Quater.. Sci., 16, 565-573).

Work on multi-millennial ocean mode runs simulating present day and glacial oxygen isotope signals in ocean waters was completed, showing the importance of advection for local balance, and the importance of the Bering Strait for the present North Atlantic oxygen isotope:salinity relationship (Wadley, M. R., G. R. Bigg, E. J. Rohling and A. J. Payne, 2002, On modelling present day and last glacial maximum oceanic d 18O distributions, Glob. Planet. Change, 32, 89-109). Current isotope:salinity relationships could not be extended to the glacial period.

Work continued on compiling a large data set of magnetic measurements of IRD on cores over the North Atlantic and present day and LGM times (Sarah Watkins, PhD student, with G. Bigg, UEA & B. Maher, Lancaster).

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EELCO J. ROHLING, Southampton Oceanography Centre, Southampton

Several of the Southampton group's (ongoing) 2002 projects are relevant to the scientific remit of IMAGES. The following summary gives the names of Southampton-based or -affiliated researchers that significantly participated in these projects. Casford, Abu-Zied, Hayes, Cane, Thomson, Rohling, and Cooke studied high-resolution records from the Mediterranean Sea, with particular emphasis on the intervals between the LGM and the Present, and Isotope Stage 5e. Hoogakker, Roberts, and Rohling investigated longer Pleistocene records, using CALYPSO cores that were recovered during cruise MD81, 1995. The Mediterranean studies used material obtained from piston and gravity cores, as well as material recovered by ODP in the Mediterranean.

An ongoing collaboration with Paul Mayewski in Maine has led to new insights about the timing and mechanisms of millennial-scale variability during the last glacial maximum, and about Holocene climatic interactions (Rohling, Challenor, Casford, Hayes, Abu-Zied).
Finally, we have been involved in modelling-based studies relevant to the understanding of Quaternary climate change. One project involve a joint effort with Bigg and Wadley at UEA. The other project concentrates on the development of a realistic strait+basin model for the Red Sea, which is being applied for the study of past sea-level variations (Siddall, Rohling, Smeed).
Rohling and Casford [now Durham] had a successful application for CALYPSO coring in the Adriatic and Aegean Seas, eastern Mediterranean, provisionally scheduled for 2004.

2002 papers:

Rohling, E.J., Mayewski, P.A., Hayes, A., Abu-Zied, R.H., and Casford, J.S.L., Holocene atmosphere-ocean interactions: records from Greenland and the Aegean Sea, *Climate Dynamics, 18*, 587-593, 2002.

Wadley, M.R., Bigg, G.R., Rohling, E.J., and Payne, A.J., On modelling present day and last glacial maximum oceanic $\delta^{18}O$ distributions, *Global and Planetary Change*, *32*, 89-109, 2002.

Rohling, E.J., Casford, J., Abu-Zied, R., Cooke, S., Mercone, D., Thomson, J., Croudace, I., Jorissen, F.J., Brinkhuis, H., Kallmeyer, J., and Wefer, G., Rapid Holocene climate changes in the eastern Mediterranean, in F. Hassan (ed.) *Droughts, Food and Culture: Ecological Change and Food Security in Africa's Later Prehistory*, pp. 35-46, Kluwer Academic/Plenum Publishers, London, 2002.

Cane, T., Rohling, E.J., Kemp, A.E.S., Cooke, S., and Pearce, R.B., High-resolution stratigraphic framework for Mediterranean sapropel S5: defining temporal relationships between records of Eemian climate variability. *Palaeogeography, Palaeoclimatology, Palaeoecology, 183*, 87-101, 2002.

Casford, J.S.L., Rohling, E.J., Abu-Zied,R., Cooke, S., Fontanier, C., Leng, M., and Lykousis,V., Circulation changes and nutrient concentrations in the Late Quaternary Aegean Sea: A non-steady state concept for sapropel formation, *Paleoceanography, 17*, 2000PA000601, pp. 14.1-14.11, 2002.

Rohling, E.J., Cane, T.R., Cooke, S., Sprovieri, M., Bouloubassi, I., Emeis, K.C., Schiebel, R., Kroon, D., Jorissen, F.J., Lorre, A., and Kemp, A.E.S. African monsoon variability during the previous interglacial maximum, *Earth and Planetary Science Letters, 202*, 61-75, 2002.

Siddall, M., Smeed, D., Mathiessen, S., and Rohling, E.J., Modelling the seasonal cycle of the exchange flow in Bab-el-Mandab (Red Sea), *Deep-Sea Research I, 49*, 1551-1569, 2002.

Casford, J.S.L., Rohling, E.J., Abu-Zied, R.H.., Jorissen, F.J., Leng, M., and Thomson, J. A dynamic concept for eastern Mediterranean circulation and oxygenation during sapropel formation, *Palaeogeography, Palaeoclimatology, Palaeoecology, 190*, 103-119, 2003.

Dinarès-Turell, J., Hoogakker, B.A.A., Roberts, A.P., Rohling, E.J., and Sagnotti, L., Quaternary climatic control of biogenic magnetite production and eolian dust input in cores from the Mediterranean Sea, *Palaeogeography, Palaeoclimatology, Palaeoecology, 190*, 195-209, 2003.

Rohling, E.J., Mayewski, P.A., and Challenor, P., On the timing and mechanism of millennial-scale climate variability during the last glacial cycle, *Climate Dynamics*, in press 2002/03 (on-line available, number DOI 10.1007/s00382-002-0266-4).

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