Prof. Dr. Christian Hübscher
Institute of Geophysics, CEN - Center for Earth System Research and Sustainability
Bundesstraße 55
20146 Hamburg
Tel.: +49 40 42838 5184
Fax: +49 40 42838 5441
email: Christian.Huebscher@uni-hamburg.de

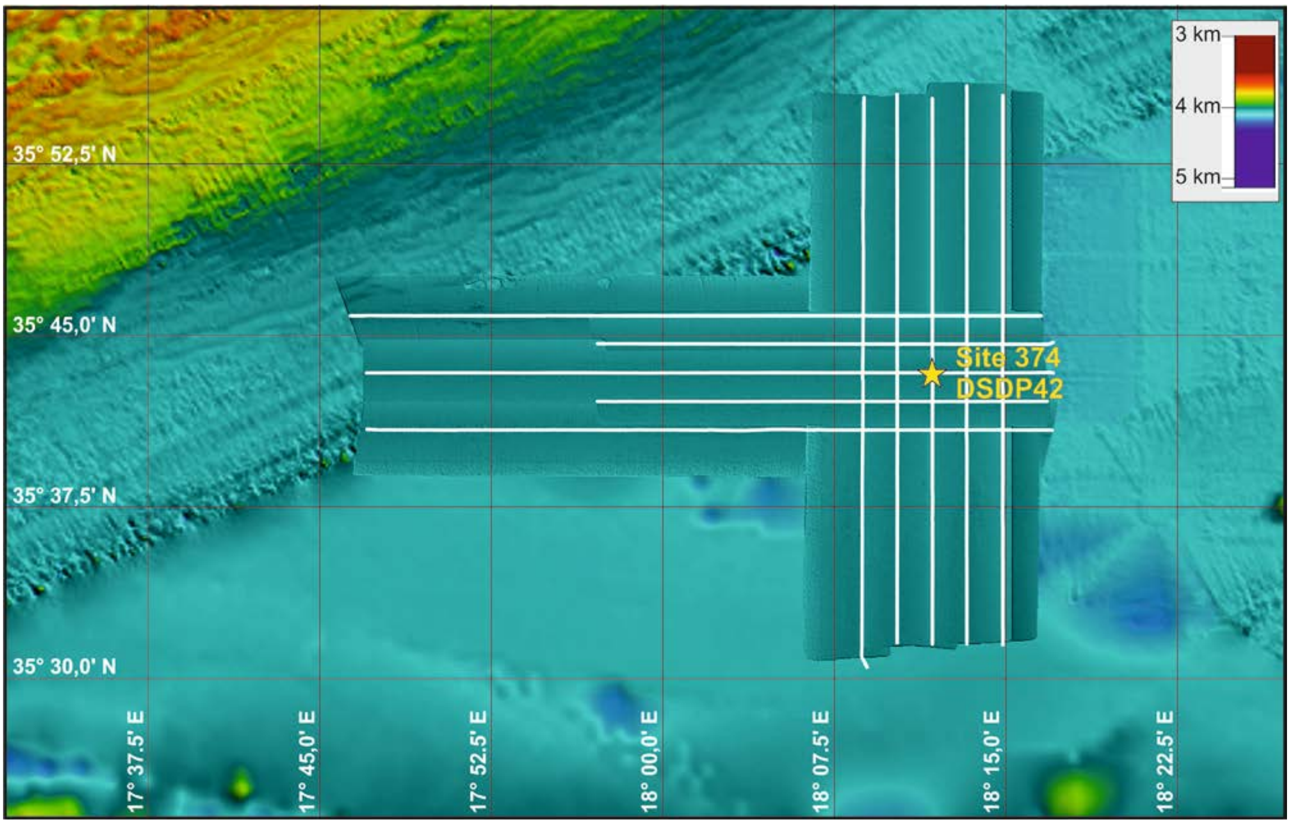
Short Cruise Report
RV Meteor M144/2

Catania (Italy) – Mindelo (Cape Verde)

January 23 – February 10, 2018

Chief Scientist: Christian Hübscher

Captain: Detlef Korte



Objectives

Deciphering exact mechanisms for the formation of massive dolomite deposits remains an outstanding enigma in sedimentary geology. However, the common association of dolomite with salt giant deposits has long been recognized. A noteworthy 33.5 m-thick dolomite sequence capping the salt giant of the Messinian Salinity Crisis (MSC: 5.97-5.33 Ma) was recovered during drilling across the Miocene/Pliocene boundary at DSDP Leg 42A, Site 374 in the Ionian Abyssal Plain. At this location, the lowermost Pliocene sequence (Unit II) comprises a dolomicrite with an unusual crystal morphology, which is a diagenetic replacement product of the original pelagic calcite ooze. The underlying end Messinian dolomitic mudstone with minor gypsum layers (Unit III.a) contains Ca-rich dolomite with white spherules (up to 4-mm diameter) of lüneburgite scattered throughout. Both the lüneburgite and gypsum within Unit III.a dolo-mitic mudstone sequence were interpreted to have a secondary origin. Unit III.a dolomite was considered to have formed in alkaline lakes with reduced salinity, collectively known as the "Lago Mare". Thus, Unit III.a sediments were deposited as a transitional facies between the MSC evaporite complex and the more open-marine Pliocene pelagic sediments. Although the geographic limits of this lacustrine basin are not well-defined by seismic data, a thin un-deformed MSC upper unit apparently overlays the MSC salt body implying that the dolomite mudstone sequence could be extensive in thickness and areal extent.
Additionally, the original shipboard interstitial water geochemical profiles indicate that saline brine is diffusing upwards from below and into the early Pliocene dolomicrite sequence. Modern bacterial sulfate reduction in this boundary zone between the evaporitic dolomite and normal pelagic sediments is reflected by a significant decrease in sulfate concentrations, whereas the chloride profile remains constant. It was previously concluded that the lowermost Pliocene marine sediments of Unit II had been dolomitized after burial as a consequence of ionic migration. Also, Unit III.a lüneburgite is a secondary product precipitated from the upward migrating brines derived from the underlying evaporites apparently composed of highly soluble Mg-and B-salts.
In summary, biogeochemical conditions promoting subsurface diagenetic alteration of earliest Pliocene/latest Miocene sediments appear to be active at present. We propose that, at the location of DSDP Leg 42A, Site 374, modern dolomite precipitation is occurring and the site is a "natural laboratory" in which to investigate the bio-geochemical phenomenon associated with subsurface diagenetic dolomite formation in the context of a salt giant deposit.
During four days we conducted reflection seismic and hydroacoustic measurements. We measured along 11 profiles, centered on DSDP Leg 42 Site 374. The towed seismic equipment comprised a digital 144-channel streamer and a DELTA sparker as the electric seismic source. PARASOUND and multi-beam data (SIMRAD system) were recorded simultaneously.

Narrative

A first group of scientist arrived at RV METEOR, berthed in the harbour of Catania/Sicily, on Saturday 20nd in the afternoon, where we discussed the unloading and loading procedure, scheduled for the 22nd. Due to a malfunction of the harbour crane no single container movement was possible. Therefore, loading was re-scheduled to the 23rd. Deck and lab installations lasted until the late evening, shortly interrupted by welcoming the main group of the expedition participants. RV METEOR left harbour at 19:00 bounded south-eastward and towards the central Ionian Sea, where we arrived next morning, the 24th. The seismic streamer was deployed and tested. Visual search for aquatic mammals started in the afternoon, but no Cetaceans were observed. We than deployed the electric seismic source, a so called Sparker. After arriving in the research area the first signals were released, starting at lowermost energy level. Over 20 minutes we ramped up the energy until maximum. At that time we also commenced the hydroacoustic measurements. The systems comprised the parametric sediment subbottom profiler Parasound and the multi-beam system EM122. The first profiles stroked W-E and E-W. A short inspection of the source during the 25th proved that the electrodes burned equally. Without any significant maintenance we restarted the measurements with a ramp-up after marine mammal observation. Profiling around DSDP site 374, drilled in 1975, continued until the 28th in the morning. All gear was on deck at 10:00 and we started our westbound transit. We passed the Strait of Gibraltar on February 2nd and arrived at Las Palmas on the 5th early morning. The crew put one winch on the pier and we commenced our transit next morning. The expedition ended after arrival in Mindelo / Cape Verde on the 10th in the morning.

Acknowledgements

The M144/2 scientific party wishes to thank Master Detlef Korte and his crew for their outstanding support throughout the cruise. We are further grateful for the support of Control Station German Research Vessels, Briese Research, Dietmar Flink from the Federal Foreign Office and our embassy in Roma. We further acknowledge the support by Angelo Camerlenghi (OGS, Trieste) and Judy McKenzie (ETH Zürich) for their contributions during the preparation of the cruise proposal.

Participants

Name	Discipline	Institution
Christian Hübscher	Chief Scientist	CEN-IfG
Niklas Ahlrichs	Seismic and Hydroacoustic	CEN-IfG
Marie Blum	Senior Scientist	CEN-IfG
Edy Forlin	Observer	OGS
Laura Frahm	Observer	CEN-IfG
Henrik Grob	Biogeochemistry	CEN-IfG
Hendrik Huster	Volcanology	CEN-IfG
Karsten Kürbis	Volcanology	DWD
Paraskevi Nomikou	Volcanology	UA-GC
Jonas Preine	Petrology, Geochemistry	CEN-IfG
Andreas Raeke	Petrology, Geochemistry	DWD

CEN-IfG
Institut für Geophysik
Universität Hamburg
Bundesstraße 55
20146 Hamburg / Germany

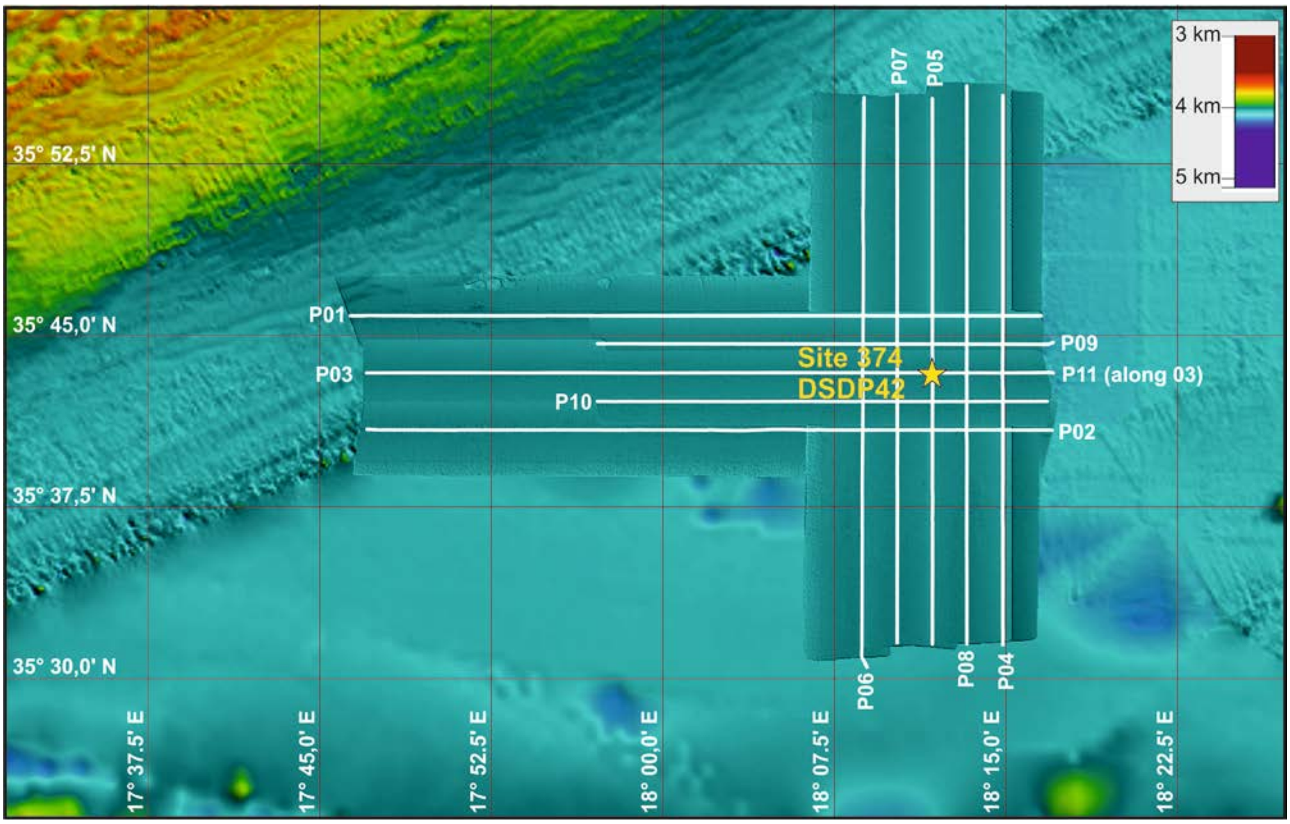
DWD
Deutscher Wetterdienst
Geschäftsfeld Seeschifffahrt
Bernhard-Nocht-Straße 76
20359 Hamburg / Germany

OGS
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
Borgo Grotta Gigante 42/C
34010 Sgonico, Trieste, Italy

UA-GC
National & Kapodistrian University of Athens
School of Science
Faculty of Geology and Geoenviroment
Dept. of Geography and Climatology
Panepistimioupolis, Zographou
157 84 Athens / Greece

Station List

Station Number	MCS Profile	Start	Start Time (UTC)	Start Latitude (°N)	Start Longitude (°E)	End	End Time (UTC)	End Latitude (°N)	End Longitude (°E)	Length (km)
M144/2_2-1	01	24.1.18	22:23	35° 53’	017° 47’	25.1.18	04:30	35° 53’	018° 17’	44.1
M144/2_2-1	02	25.1.18	05:59	35° 48’	018° 17’	25.1.18	11:49	35° 48’	017° 47’	45.3
M144/2_2-1	03	25.1.18	13:46	35° 50’	017° 47’	25.1.18	19:42	35° 50’	018° 17’	45.0
M144/2_2-1	04	25.1.18	23:21	35° 39‘	018° 14’	26.1.18	05:02	36° 03’	018° 14’	43.3
M144/2_2-1	05	26.1.18	06:04	36° 03‘	018° 11’	26.1.18	11:44	35° 39’	018° 11’	42.7
M144/2_2-1	06	26.1.18	15:07	35° 39‘	018° 08’	26.1.18	21:04	36° 03’	018° 08’	44.7
M144/2_2-1	07	26.1.18	21:36	36° 03‘	018° 10‘	27.1.18	03:37	35° 39’	018° 10’	44.7
M144/2_2-1	08	27.1.18	04:32	35° 39’	018° 13‘	27.1.18	10:31	36° 03‘	018° 13‘	45.6
M144/2_2-1	09	27.1.18	13:56	35° 52‘	018° 17‘	27.1.18	17:58	35° 52‘	017° 56‘	31.4
M144/2_2-1	10	27.1.18	18:44	35° 49‘	017° 56‘	27.1.18	22:45	35° 49‘	018° 17‘	30.1
M144/2_2-1	11	27.1.18	23:08	35° 50‘	018° 17‘	28.1.18	05:13	35° 50‘	017° 47‘	45.6



Basemap with EMOD bathymetry in background and EM122 data from M144/2 cruise above. White lines indicate Sparker multi-channel profiles. Profile 11 runs along previous profile 03.