Multibeam backscatter-driven investigations reveal previously unknown cold seeps in the southeastern Tyrrhenian Sea

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New acquisition EM710
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mud volcano RMV - BOXCORE

SEM images

XRD: goethite

5 cm

Fe

Mn

goethite → oxic geochemical zone
mud volcano RMV - BOX CORE

SEM: pyrite

SEM: sulfur

5 cm

mud volcano R1MV - CORE

Cu

Fe

sulfurs

sulfidic geochemical zone
Siderite – mudstone at optical microscope

mud volcano RMV

XRD analysis: siderite

5 cm

Siderite – mudstone at optical microscope

siderite → methanogenic geochemical zone
a) distal mudflow

SW

800 m

ascending gas disrupting the mudflow continuity = higher backscatter

GC10

RMV slope

lower backscatter

700 m

b) proximal mudflow

800 m

preserved mudflows = lower backscatter

c) R1MV slope

proximal mudflow lower backscatter

distal mudflow higher backscatter

d) distal mudflow

ascending gas disrupting the mudflow continuity = higher backscatter

GC10

proximal mudflow

GC30

more preserved mudflows = lower backscatter

GC29

800 m

800 m

e) GC30

gc12

distal mudflow higher backscatter

GC12

GC29

GC10

GC29

GC30

diapir D1 – authigenic dolomite with oxyhydroxides coating, serpulids traces

SEM: neovolcanic pyroxen in the carbonatic matrix

Optical microscope: bioclastic wackestone

Lucinids and crustaceans

Calliax lobata
Gas flares detected in the water column above the Håkon Mosby mud volcano using a 38-kHz echosounder of the R/V Pourquoi pas? during the Vicking cruise in 2006. Foucher et al. (Geo Mar Lett, 2010).
In 2009 onboard Okeanos Explorer (NOAA) a previously undiscovered 1400-meter-high plume was imaged offshore of northern California with a Kongsberg EM302 multibeam echo sounder. The plume disappears from the water column at roughly 400 meter water depth. Gardner et al. (EOS, 2009)
We run the test above the point where gas emission was revealed during core recovery with a Kongsberg EM710 multibeam echo sounder while doing a CTD cast. It operates at sonar frequencies in the 70 to 100 kHz range. The area insonified is about 19.5 square kilometers (7.52 square miles) and his depth changes from 700 to 900 meters.
FMMidwater Water column feature extraction tool

- Step 1: Import sonar file
- Step 2: Convert to GWC format and downsample
- Step 3: Identify features of interest
- Step 4: Export to Fledermaus objects
First, we reduced the number of beams and the beam range, in order to isolate the plume that the instrument detected during the survey. We cut also the depth range.
Backscatter pattern allowed to map:
- VHBS active seafloor venting sites
- HBS gas seepage
- LBC carbonate clogged gas seepage

Backscatter-driven sampling allowed to locate different vertical geochemical zones

\[3H_2S + S_0 + Fe_2O_3 = 2FeS_2 + 3H_2O\]  
(Berner, 1981)

\[7CH_2O + 2Fe_2O_3 = 3CH_4 + 4FeCO_3 + H_2O\]  
(Curtis, 1986)