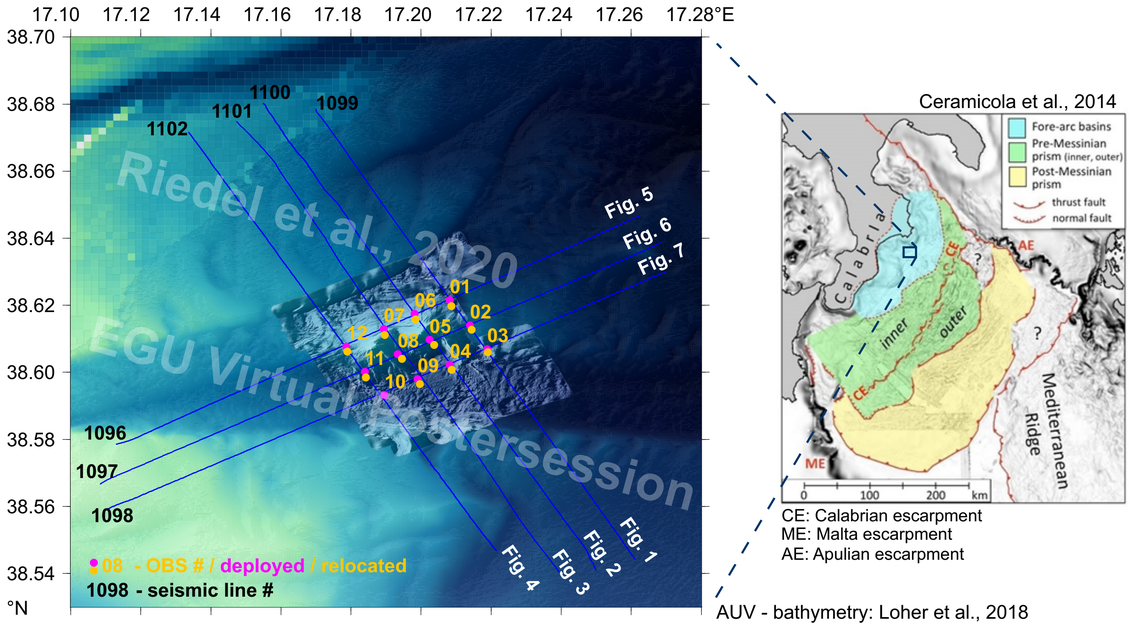
Internal Structure of Venere Mud Volcano in the Crotone Forearc Basin, Calabrian Arc, Italy, from Multibeam Bathymetry, Wide-Angle, and Multichannel Seismic Data

Michael Riedel [1], Anne Krabbenhoeft [1], Cord Papenberg [1], Jörg Bialas [1], Gerhard Bohrmann [2], Silvia Ceramicola [3]

[1] GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany
[2] University of Bremen, Department of Geosciences / MARUM, Bremen, Germany;
[3] OGS Trieste, Italy

Bathymetry and location map of Venere Mud Volcano



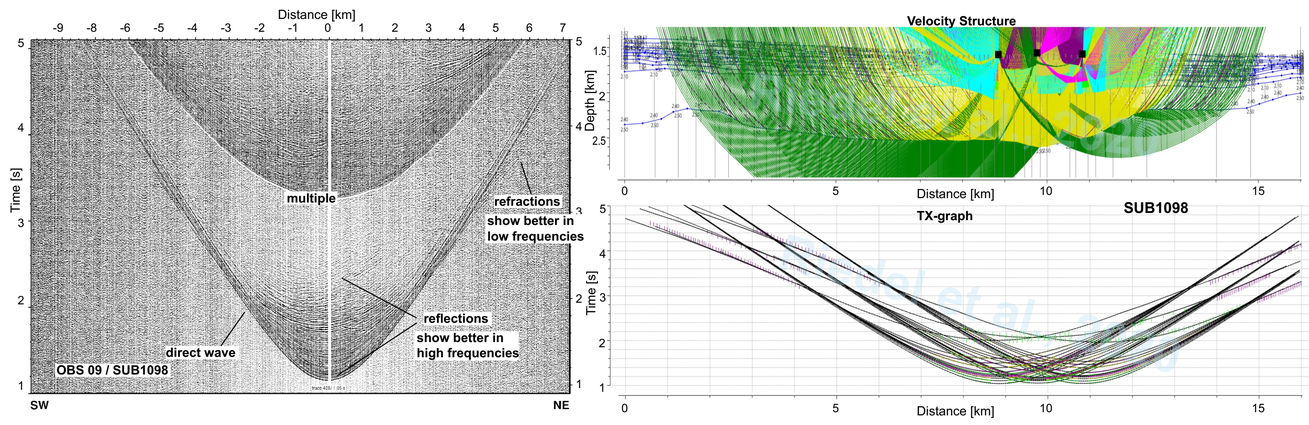
CE: Calabrian escarpment
ME: Malta escarpment
AE: Apulian escarpment

AUV - bathymetry: Loher et al., 2018

Introduction and objectives

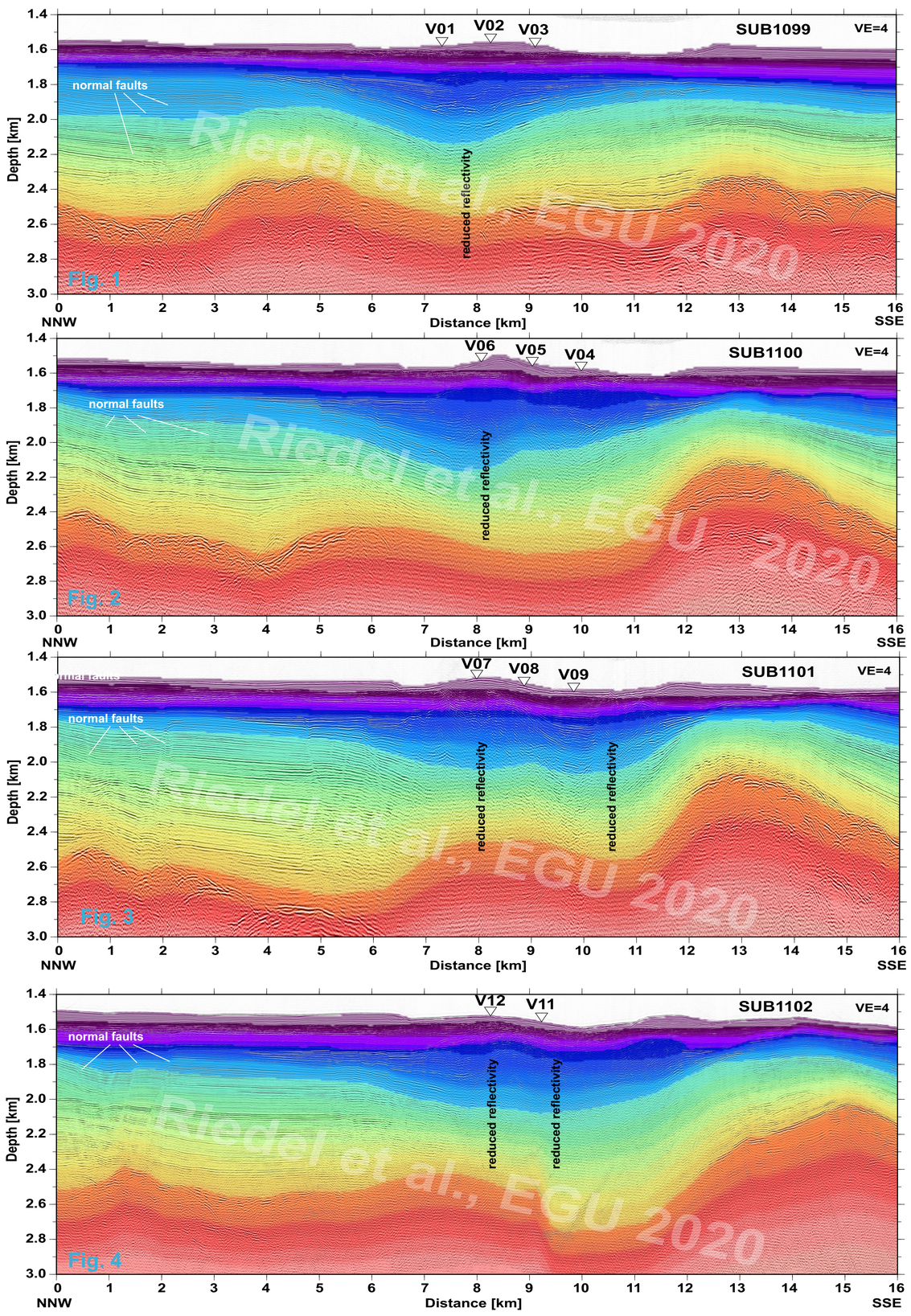
Mud volcanoes (MVs) have been found in various geological settings on passive and active margins but are mostly known from collision zones on Earth. Several submarine MVs locate in the Calabrian arc, offshore southern Italy. **To contribute to the knowledge of submarine MVs**, in particular the **internal structure across Venere MV**, we used high resolution multibeam bathymetry, (constraining seafloor expressions), wide-angle, and multichannel seismic data (constraining the P-wave velocity distribution and internal structure).

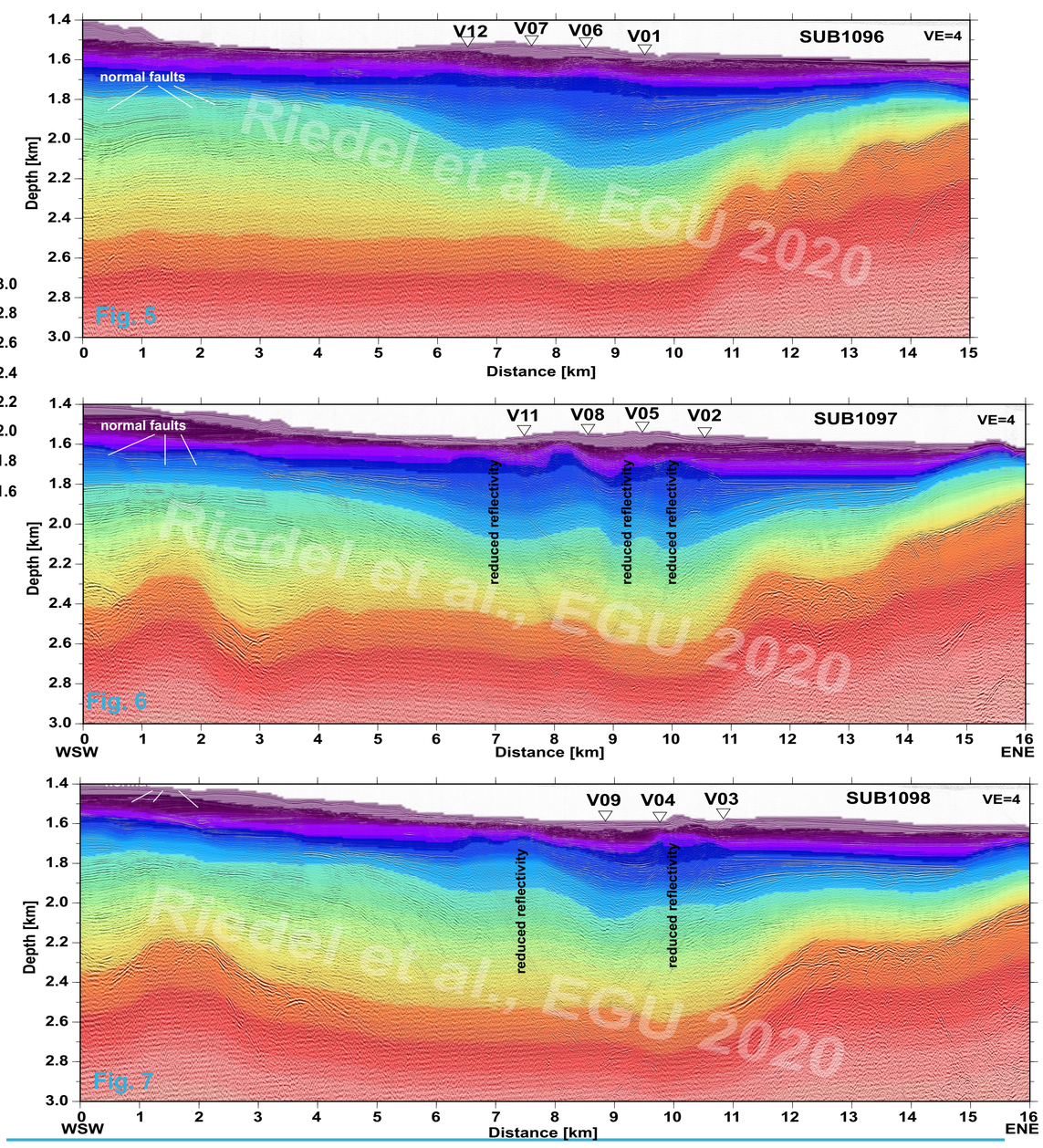
Ocean bottom hydrophone (OBH) data example - raypaths through the model and traveltime curves - one example



Velocity structure: Note higher ray density, and therefore model resolution in the center beneath OBS stations (cubes).
TX-graph: Vertical colored lines are picked reflections/refractions; black lines are calculated traveltime curves.

Wide angle seismic P-wave velocity models - superimposed on coincident multichannel seismic data





Results

From the bathymetric surface expression:
Venere MV dimension is ~10 km in the EW- and ~7 km in the NS-direction in a water depth of ~1500 m. Two circular cones of ~100 m elevation and ~1.5 km diameter locate in the MV center.

The sub-seafloor structure from seismic constraints:
The upper 200 m (sub-) parallel layers to and below the seafloor (bsf) show seismic P-wave velocities gradually increasing from 1.53 to 1.7 km/s. A prominent reflection ~200 m bsf and a sudden increase of seismic P-wave velocities from 1.7 to 1.8 km/s mark a change with depth in the internal structure, where reflections dip, and seismic P-wave velocities laterally decrease towards the center of Venere MV. Two separate feeder conduits of the two center cones correlate with reduced amplitude/chaotic reflections and reduced P-wave velocities at 4 km across and 200 m bsf and downwards. However, the roots of the MV are beyond our depth penetration. The rough reflections of the acoustic basement in depths vary from 500 m to 800 m bsf. Here, reduced reflectivity occurs beneath the center of the MV as well. Mapping of the fault system leads to the subseafloor dimension of Venere MV that exceeds its seafloor dimension by the factor of two.

Acknowledgements and *References*

This work is funded by the Deutsche Forschungsgemeinschaft, DFG, grant number BO 1049/22-1 | RI 2107/2-1. We thank the Captain and Crew of POS515 for their professional help with the data acquisition. Seismic Unix was partially used for seismic data processing (Cohen and Stockwell, 2010). Pasteup and Modeling (Fujie, et al., 2008) was used for the wide-angle traveltime forward inversion. Most of the figures were made with the Generic Mapping Tool (GMT) free software (Wessel and Smith, 1998).

Ceramicola S, Praeg D, Cova A, Accetella D and Zecchin M (2014) Seafloor distribution and last glacial to postglacial activity of mud volcanoes on the Calabrian accretionary prism, Ionian Sea. Geo-Marine Letters 34: 111-129.

Loher, M., Ceramicola, S., Wintersteller, P., Meinecke, G., Sahling, H., & Bohrmann, G. (2018). Mud volcanism in a canyon: Morphodynamic evolution of the active Venere mud volcano and its interplay with Squillace Canyon, Central Mediterranean. Geochemistry, Geophysics, Geosystems, 19, 356– 378. https://doi.org/10.1002/2017GC007166

HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES