EXPLORING SEABED SEEPAGE FEATURES ON THE CALABRIAN ACCRETIONARY PRISM

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Abstract

The distribution of cold seeps in relation to the seabed tectonic features of the Calabrian Arc is examined using multibeam data.Integration of swath bathymetry with backscatter data indicates the presence of at least 40 seepage sites, recognized as sub-circular to elongate high backscatter patches of varying form *(e.g. cones, calderas, domes, pies, scarps).* Many resemble mud volcanoes, proven at several sites by seismic and core data. Most cold seeps lie on the inner to central Arc, a distribution inferred to reflect the long-term dynamics of the accretionary prism.

Keywords: Mud Volcanoes, Swath Mapping, Active Margins, Geomorphology

A new Mediterranean cold seep province was discovered offshore southern Italy during the summer 2005 campaign of the Italian research vessel OGS Explora, which acquired the first regional multibeam coverage of the Calabrian accretionary prism [1, 2]. Detailed investigations at two sites provided seismic and sample evidence of tectonically-driven mud volcanism since the late Pliocene [3]. These two sites were further investigated during two campaigns equipped with remotely-operated vehicles (ROVs), which found seabed evidence of geological and biological seepage activity [4, 5]. Here we present new information regarding the wider distribution of cold seeps across the accretionary prism in relation to its main tectonic features.

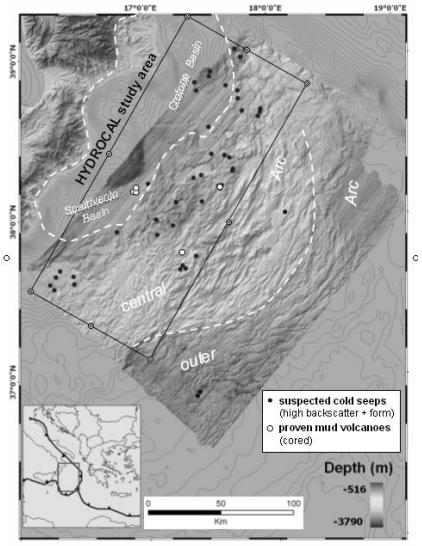

Fig. 1. Distribution of seepage sites across the Calabrian accretionary prism as inferred from integration of multibeam swath bathymetry and backscatter data

Multibeam data across water depths of c. 1000-4000 m reveal the main seabed tectonic features of the Calabrian Arc, within three main zones [cf. 6]: inner forearc basins (Spartivento-Crotone), a central thrust-fold belt and the outer cobblestone area (underlain by Messinian evaporites). Integration of swath bathymetric and backscatter data indicates the presence of at least 40 sites of seabed seepage across the inner and central Arc, recognized as sub-circular to elongate high backscatter patches of varying form. Some features lie along linear trends that appear to correspond to seabed fault scarps. Many features have forms that resemble mud volcanoes (cones, calderas, domes, broad pies). Mud volcanoes (MVs) are proven at three main sites by cores of mud breccias, complemented by seismic profiles: the Madonna dello Ionio MVs (including three extrusive centres, 1.5-3 km in diameter), the Pythagoras mud volcano (a mud pie up to 9 km in diameter) and the Sartori MV (a small dome c. 1.5 km across). The latter is identified from cores of 'chaotic sediments' recovered in 1981 and originally interpreted as tectonic breccias [7]. The former two features have been shown to be the tops of subsurface extrusive edifices >1 km thick that record extrusive activity and subsidence over several million years, triggered by the rise of fluids from deep within the accretionary prism [3]. This model of tectonically-driven fluid escape is consistent with the observed distribution of cold seeps, which (as on the Mediterranean Ridge) are absent on the outer Arc where thick evaporites have been incorporated into the accretionary prism.

Seabed investigations of the Madonna and Pythagoras mud volcanoes provide evidence of ongoing seabed seepage of gas (methane) and warm mud, in places supporting chemosynthetic ecosystems [4, 5]. Gas seepage is also indicated by acoustic data acquired by OGS in 2009 across a mud volcano 6 km offshore Catanzaro Marina (Calabria , Italy). At present we have no information as to how many other seepage sites on the Calabrian Arc are currently active, whether gas hydrates are present, the type and quantities of gases and/or fluids that are being released into the water column, or the forms of chemosynthetic microbial and macrofaunal life that may be supported by seabed emissions of hydrocarbons. Preparations are underway to undertake further multidisciplinary investigations of seabed hydrocarbon seepage in the Calabrian Arc cold seep province (OGS HYDROCAL proposal).

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