Geophysical Research Abstracts, Vol. 9, 03501, 2007
SRef-ID:

The structure, origin and bathymetric expression of mud volcano craters: examples from the South Caspian Sea and eastern Azerbaijan

R. J. Evans (1), S. A. Stewart (2) and R. J. Davies (3)

(1) School of Earth, Ocean and Planetary Sciences, Cardiff University, UK, (2) BP Azerbaijan, Baku, Azerbaijan, (3) CeREES, (Centre for Research into Earth Energy Systems), University of Durham, UK (evansrj8@cf.ac.uk / Fax: +44 (0) 29 2087 4326 / Phone: +44 (0) 29 2087 5434)

Mud volcanism is an important fluid dynamic process that is frequently manifest at the seabed as structures ranging from simple conical mounds to more complex depressions and associated faults. Little is known about the subsurface processes that are responsible for this range of morphologies, how the surface features link to deeper sections of the mud volcano system and what their role is in the system's evolution. Here we use seismic and bathymetry data from the South Caspian Sea alongside field data from eastern Azerbaijan in an attempt to characterize the bathymetric and surface expression of mud volcano source points. In particular we focus on the mud volcano crater, which we define as a more or less circular depression found at the summit of a mud volcano edifice.

Analysis of submarine examples within our study area indicates that volcano craters are likely to consist of a number of common structural and geomorphological elements that can be readily identified using bathymetry data. By mapping onshore craters that show a similar morphology we have been able to ground truth these data and identify the structural and geomorphological features responsible for the bathymetric character. These observations are summarized in a model of typical crater structure. Included in the model is a subcircular crater rim that defines the topographic boundary of the crater, a crater margin ring fault, a marginal depression and a series of intra-crater extruded deposits. Similar crater structures are observed at a number of volcanoes outside the Caspian region indicating that the model may be of broad applicability to other mud volcanoes that develop circular craters. The model therefore provides a list of terms and a structural framework that may be useful to those describing and comparing mud volcano craters from within and outside the Caspian region using

bathymetry data. In addition, the close similarity of our model to those for the structure of magmatic calderas indicates the potential analogue value of mud volcanoes to the study of igneous volcanism.

Further insights from 3D and 2D seismic reflection images, together with our surface observations, have enabled us to propose two possible mechanisms of crater formation. Firstly is the upward propagation of circular feeder system faults to the surface from depth. Another is the volume loss resulting from the removal and eruption of material from within a shallow “mud reservoir” beneath the crater. Primary intrusive mud chambers, thought to exist beneath some mud volcanoes offshore Trinidad, may provide such a reservoir. In the Caspian region a more plausible explanation is suggested by seismic lines that show evidence for the remobilization and “secondary” extrusion of previously erupted sediment sourced either from within an extinct buried edifice or from within deep sections of the presently active edifice itself. An origin relating to gravity-induced slope failure is deemed unlikely due to the circularity of the crater margin fault and the lack of any indicators of strike-slip displacement along the lateral crater margins.