P-42 ITALIAN MUD VOLCANOES – OCCURRENCE AND GEOCHEMICAL CHARACTERISTICS

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Abstract

Mud volcanoes are a surface evidence of accretionary complexes and widely outcrop all over the world, mainly along continental margins. Structural and geochemical characteristics of mud volcanoes are consistent with confined fluid reservoirs, located along tectonic disturbances. Brackish waters whose intense bubbling releases abundant quantity of gases, mainly methane, fill the cones of mud volcanoes. In Italy, mud volcanoes generally outcrop in correspondence of the external margin of the Apenninic chain, usually under compressive collisional stress conditions, while distensive areas host CO₂ emissions called "mofettes", methane characterizes the properly called mud volcanoes. In northern Italy mud volcanoes are localized in Emilia Romagna region; in central Italy mud volcanoes occur in the Marche region and minor manifestations are observed in the eastern apenninic sector of the Abruzzo region; in southern Italy mud volcanoes crop out in Benevento province while in Avellino and Salerno provinces manifestations of "mofettes" are found (fig. 1; tab. 1). Similar tectonic features characterise the Mediterranean Ridge where many mud volcanoes offshore manifestations have been observed. Geochemical investigations revealed that mud volcanoes are natural strain meters and could be useful in earthquake forecasting. In particular, variations in the radon content of the fluid phase are now considered as a seismic precursors, since they are directly linked to fluids velocity changes and thus to deformation rates at deeper crustal levels. In many mud volcanoes of northern Italy a quite high concentration of radon parent radionuclides has been observed, which is peculiar of brackish water associated with hydrocarbons. Radon was monitored both in the gas and in the liquid phase of mud volcanoes of Emilia Romagna region (fig. 2); effectively radon variation in the liquid phase was evaluated as a significant precursor of local seismic activity. Also the automatic monitoring of the radon content in the gas phase appears to be a suitable approach to mud volcano monitoring, even if sometimes results show a worse signal/noise ratio. The good results encourage to apply this kind of approach on a regional scale, together with the monitoring of other physical and chemical parameters, in order to reach a sufficient degree of deterministic reliability. The nature and origin of waters in mud volcanoes of northern Italy has been determined by means of stable isotopes analyses and major and trace elements investigations, that ruled out any possible meteoric contribution and identified the fluids as connate waters. Moreover, the clearly biogenic signal of the carbon isotopic ratio is consistent with the typical composition of Italian foredeep gases.

The similarity between the geodynamic setting of Apenninic mud volcanoes and that of Mediterranean Ridge offshore manifestations allow us to formulate some considerations: the occurrence along compressive margins confirms the link between upwelling fluids and tectonic regime. Thus, mud volcanoes are the channelways along which deep fluids can migrate up to the

surface and the pre-seismic processes manifest themselves through geochemical modifications in fluid-phase composition.

Site	Latitude	Longitude
Casalfiumanese	44.2978	11.6172
San Martino in Pedriolo	44.3536	11.5728
Casalfiumanese	44.2978	11.6172
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Imola	44.3533	11.7139
Ozzano dell'Emilia	44.4439	11.4736
Aidone	37.415	14.4464
Valguarnera Caropepe	37.495	14.3889
Villarosa	37.5856	14.1733
Caltanissetta	37.4903	14.0567
Lercara Friddi	37.7475	13.6033
Cammarata	37.6325	13.6369
Casteltermini	37.54	13.645
Zorba	37.3922	13.6239
Palazzo Adriano	37.6811	13.3789
Cattolica Eraclea	37.4389	13.395
Maiolati Spontini	43.4761	13.1203
Moie	43.5028	13.13
Monte Roberto	43.4806	13.1383
San Paolo di Jesi	43.4539	13.1739
Battinebbia	43.4575	13.1675
Monte Rinaldo	43.0275	13.5797
Poggio Canoso	42.9464	13.5425
Rotella	42.9539	13.5606
Vallone	43.1383	13.7228
Petriano	43.7797	12.7339
Isola del Piano	43.7364	12.7825
Saltara	43.7533	12.8972
Capodarco	43.1886	13.7614
Mogliano	43.1853	13.4792
Santo Stefano	43.5083	13.4611
Aspio	43.5333	13.5011
Serra de' Conti	43.5425	13.0367
Teramo	42.6586	13.7039
Cellino Attanasio	42.5856	13.8594
Pineto	42.6081	14.0672
Cellino Attanasio	42.5856	13.8594
Chiovano	42.5353	13.6711
Picciano	42.4739	13.9908
Frissa	42.2617	14.3675
Poggiofiorito	42.2553	14.3233
Castelfranco in Miscano	41.2969	15.085
Cancellara	40.7308	15.9231
Offida (Contrada S.Lazzaro)	42.9349	13.6906
San Vincenzo La Costa (San Sisto)	39.364	16.1511
Paternò	37.5659	14.9017
Palizzi Marina	37.9995	15.9555
Siderno	38.3333	16.25

Tab. 1 List of italian mud volcanoes and their geographic localization

Fig. 1 Distribution of mud volcanoes in Italy.

Fig.2 Example of Emilia Romagna mud volcano.

MAP OF MUD VOLCANOES OF ITALY