MUD BRECCIAS AND HEMIPELAGIC DRAPES OF MUD VOLCANOES FROM THE WEST ALBORAN BASIN: GEOCHEMICAL AND MINERALOGICAL CHARACTERIZATION.

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Abstract

Mud volcanoes from the West Alboran Basin were first discovered and surveyed during several TTR cruises. Provenance and nature of the mud breccias extruded by the Alboran mud volcanoes have been investigated by using geochemical and mineralogical proxies. This study presents preliminary results obtained from the analyses of mud breccia and pelagic drapes from gravity cores collected at different mud volcanoes (Perejil, Dhaka, Carmen and Maya). Mineralogical analyses showed a clay dominant composition of mud breccias, and major and trace element composition have revealed potential differences in parental affinity.

Keywords: Alboran Sea, Mud Volcanoes, Geochemistry, Mineralogy

Mud volcanoes were first discovered in the West Alboran Basin (WAB) during the TTR-9 cruise, in 1999 [1] and further investigated during the following TTR cruises (TTR-12, TTR-14 and TTR-17). The mud volcano field is located in the inner part of the Gibraltar Arc, where the major sedimentary depocenter is recorded (up to 7km). Previous studies have proved that this depocenter matches with an extensive Mud Diapir Province, which feeds mud diapirism and associated mud volcanoes. The mud diapirs are formed by under-compacted shales and olistostromes from the lowermost marine sedimentary sequence early to middle Miocene in age, as show both seismic interpretations [2] and micropaleontological studies of the extruded materials [3]. In order to investigate the provenance and nature of the mud breccias extruded by the Alboran mud volcanoes, we have analyzed three gravity cores (MS283G, MS285G and MS419G) from the top of Perejil, Dhaka and Maya mud volcanoes respectively, and one (MS385G) from the flank of the Carmen mud volcano. Perejil MV is located in the northern whereas Dhaka, Carmen and Maya MVs are located in the southern of the Mud Diapir Province. All of them occur between 400m and 850m depth and they are showed as positive structures. However, their morphologies are variable, ranging from semi-circular to elongated; as well as size in high, from 25m to 90m and in diameter, from 120m to 1600m. Continuous samples were taken from the hemipelagic drapes in all mud volcanoes and every 2cm at the top of the mud breccias. The rest of the mud breccias were sampled every 5 or 10cm at 2cm intervals. Samples were processed for mineralogical and geochemical analyses and different techniques were used: X-ray Diffraction (DRX), Atomic Absorption (AA) and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). The analyzed cores evidence similar bulk mineral composition at the four studied MVs. However, differences in mineral abundances could suggest a major contribution of clays in the northern volcano field as shown by the clay content at Perejil MV. In contrast, MVs from the southern volcano field (Carmen and Dhaka MVs) show similar abundances in bulk mineral components, thus supporting similar source contribution. Maya MV shows mixed bulk mineral composition. Such differences between the northern and the southern fields are further supported by the composition of the clay mineral assemblages. Differences are found in the smectite and illite abundances, being the smectites the predominant clays at Perejil MV, while illite is more abundant in Carmen and Dhaka MVs, whereas Maya MV shows particular proportions of smectite and illite. Such dissimilarities allow us to suggest distinct composition and/or depth of the source feeding materials between the northern and the southern volcano fields [table 1].

Tab. 1. Bulk mineralogy and clay mineral assemblages in mud breccias from Maya, Carmen, Dhaka and Perejil mud volcanoes.

		MAYA MV	CARMEN MV	DHAKA MV	PEREJIL MV
BULK MINERALOGY	% Quartz	5-15	15-20	15-20	5-15
	% Calcite	<5-10	10-15	<5-20	<5
	% Clays	65-90	65-75	55-75	80-90
CLAY ASSEMBLAGES	% Smectite	40-75	30-40	25-40	55-70
	% Illite	10-50	40-55	20-60	20-30
	% Kaolinite+Chlorite	10-20	10-20	15-20	<5-10

The distribution of major and trace elements across the studied intervals resulted from a large number of processes. Typical detrital elements (Al, Si, K, Mg, Rb, Th and REE), which preserve the characteristic trace-element distribution of source rocks, show that mud breccias are not chemically homogeneous, because reported down core differences in detrital-element content from Perejil, Carmen and Dhaka MVs suggest potential differences in parental affinity as divergences in the relative contribution of the diverse source layers and depths. Oscillations in redox-sensitive elements (U, Mo, V, Cr, Ni, Pb and carbonate associated elements as Sr) are observed at about the same depth than those reported for detrital elements, which also support a potential link with the nature of the source materials. Further investigation in clay mineral transformations will be need, in order to verify a potential smectite transformation in relation with a different depth source. Statistical analyses and chemical index of compositional maturity is in progress to confirm the relationship between chemical composition and source materials of the muc breccia as well as the influence of fluid activity in diagenetic process.

References

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