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Different depths of sedimentary and fluid origins in submarine mud volcanoes off Tanegashima Island, Japan

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Mud volcanoes are a topographic feature in which over pressured sediments intruded upward and erupted to seafloor, supplying fluids and sediments from deep subsurface to surface. They are a significant source of fossil methane to the hydrosphere and the atmosphere. To understand the carbon cycle through mud volcanoes, it is important to investigate the sedimentary and fluid origins. Around Japan, several tens of mud volcanoes have been found at off Tanegashima Island along the northern Ryukyu Trench where the Philippine Plate obliquely subducting beneath the Eurasian Plate. During the cruises in 2015 and 2019 by R/V *Hakuho-Maru*, we retrieved piston cores from MV#1 (30˚53´N, 131˚46´E; water depth: 1540 m), MV#2 (30˚55´N, 131˚50´E; water depth: 1430 m), MV#3 (31˚03´N, 131˚41´E; water depth: 1200 m), and MV#14 (30˚11´N, 131˚23´E; water depth: 1700 m). The vertical profiles of the Cl^- concentration in porewater show the advection rate, indicating the activity of mud volcano, are faster in the order MV#3, MV#2, MV#1, and MV#14. At the active MV #1, MV #2, and MV #3, the concentration ratios of methane to ethane (C_1/C_2: 30–50) and the stable carbon isotopic compositions of methane ($\delta^{13}C$: –57‰ to –42‰) indicate that the hydrocarbon gases are mostly derived from thermal decompositions of organic matter in deep sediments where the in situ temperature is >80˚C. At the inactive MV#14, the C_1/C_2 ratios were high as 700-4000, and $\delta^{13}C$ values of methane were ca. –75‰, respectively. The data suggest that the active methanogenesis and/or a small supply of thermogenic methane overwrite the thermogenic signals at the dormant mud volcano, MV#14. On the other hand, the vitrinite reflectance (%Ro) was almost identical (0.42–0.44%) in all mud volcanoes. The common value suggests that the erupted sediments in these mud volcanoes were derived from same strata. And, the low values indicate the organic matters are immature to produce thermogenic hydrocarbons. The immature organic matters in sediments and the existence of thermogenic methane strongly suggest that the hydrocarbon gases were supplied from deeper depths than the source strata of erupted sediments.