



Magmatic versus sedimentary volcanism: similarities of two different geological phenomena

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Sedimentary volcanoes (or more commonly called mud volcanoes) are geological phenomena that are present in sedimentary basins of passive and active margins. At these localities gas and water related to hydrocarbon diagenetic and catagenetic production generate overpressure facilitating the rise of mobile and ductily deformable materials that breach through the denser overlying rocks. The results are surface powerful manifestations of mud eruptions that strikingly resemble to those of magmatic volcanoes. Magmatic and sedimentary volcanoes share many other similarities. Initially both systems are essentially gas driven and the subsurface plumbing systems are characterized by intrusions and a complex system of fractures and conduits that bifurcate from a central feeder channel that manifest in the surface as numerous satellite seeps and vents. In both cases are inferred secondary shallower chambers where reactions take place.

Comparable structural morphologies (e.g. conical, elongated, pie-shaped, multicrater, swap-like, caldera collapse, subsiding flanks, plateau-like) and/or alteration of the original shape are in both cases related to e.g. density and viscosity of the erupted solids, to the gas content, to the frequency of the eruptions, and to the action of meteoric factors (e.g. strong erosion by rain, wind, temperature changes etc. etc.).

Like for magmatic volcanoes, the periodicity of the eruptive activity is related to the time required to charge the system and create new overpressure, as well as how the structure seals during periods of dormancy. Earthquakes are documented to be a powerful trigger capable to activate faults (often hosting magmatic and sedimentary volcanoes) and/or facilitating the breaching of the upper layers, and allowing the rise of deeper charged fluids.

Finally, both systems significantly contribute as active source for CH₄ (sedimentary) and CO₂ (magmatic) resulting of great importance for global budget estimates of sensitive gasses.

The combined characteristics and ingredients that characterize sedimentary and magmatic systems result in hybrid phenomena called "sedimentary hosted geothermal systems" (SHGS). Here igneous intrusions and high temperature geothermal fluids migrate and vent through organic-rich sedimentary units inducing hydrocarbons and geochemical alterations that trigger sedimentary eruptions in the subsurface. One of the most spectacular SHGS is the Indonesian Lusi eruption, others known examples are present in central Java, in the salton Sea (California), offshore in the Guaymas Basin, Gulf of California, and near Fiumicino, Italy; however many more are likely to exist.