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The Etnean magma: more water than basalt

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A modest 3.5 wt% is the maximum H_2O found in the Etnean olivine melt inclusions and this is supposed to be the highest water content of the Enean basalt, thus presuming a H_2O/mol basalt ratio of 0.14. This observation would support the paradigm in which all gas emitted by a volcano is originally dissolved into the silicatic melt (basalt) usually erupted by the same volcano. However, a reappraisal of published data allows a comparison between the cumulative gas emitted during non-eruptive flux and the volume of erupted lavas. The moles H_2O/mol basalt ratio is 1.41, which means that Mount Etna erupts 10 times the maximum H_2O that could be dissolved in magma and 40% more moles of gas (H_2O, CO_2 and S) than moles of basalt. From this standpoint it is possible to calculate the molar volume of the components of a basaltic melt (silicate tetrahedra and metallic cations) and of the gas phase within the feeding system at depth (say at 250 MPa, corresponding to $\sim$ 7 Km). A unitary volume of the magma thus obtained would consist of a solution made for $\sim$70% by a continuum gas phase (mostly H_2O) at a supercritical state (density 360 kg/m3) and for only the 30% by basaltic melt components. The magma would not therefore be made by a basaltic melt with a modest quantity of volatiles dissolved in it, as it is commonly believed; but, on the contrary, the gas phase would be predominant by large. The gas (mostly water) would keep the basaltic components in solution with an extremely low density. The transition from this low-density (1140 kg/m3) water melt solution (WMS) to the high- density (2800 kg/m3) basalt, usually erupted (defined as a continuous melt phase, CMP), occurs somewhere within the plumbing system, likely in the last 2 km, and marks the boundary between a deep and a shallow plumbing system. The depth of the transition is variable, being driven by the gas escape that lets the CMP to accumulate within the shallow plumbing system, until erupted. The over- pressure of the gas phase in the WMS, can act like a piston cylinder driving the eruption. The heat provided to the CMP by the gas flux has also been considered, proving that it can maintain the CMP liquid and at low viscosity. The volcano is a dynamic system in which the eruptions are boosted by discontinuities in the flux of gas and heat. A decrement of gas flux would decrease the heat supply, promote viscosity and trigger eruptions. This view of the volcanic system subverts the common idea that the gas emitted is associated with an equivalent amount of degassing magma. In this way it rules out the ‘excess degassing problem’, which worries many volcanologists around the world.