Mount Etna: Storyboard of an exceptional basaltic volcano

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Mount Etna, in Sicily, has fascinated observers since the Antiquity and, over the past decades, has gradually become one the most intensively studied/monitored volcanoes on Earth. Several features contribute to make it one exceptional basaltic volcano-laboratory: its peculiar tectonic setting and magma geochemistry (intraplate-type alkali basaltic magmatism in the context of African-European continental plate collision), its persistent activity and wide spectrum of eruptive styles (from lava effusions, lava fountains, Strombolian to Plinian explosions), its huge gas emissions (among the strongest ones worldwide), and its quite easy access (favourable to maintenance of dense monitoring networks and field testing of new technologies). These different aspects have long attracted scientists from various disciplines but also promoted increasingly pluri-disciplinary sounding of the deep roots of the volcano and its behaviour. Moreover, the continuous survey of Etna, under the responsibility of INGV, responds to the need of forecasting its eruptions and mitigating the risks to which its densely populated surroundings are exposed.

In this keynote talk, I'll provide a review of the progresses in our present-day understanding of how Mount Etna works, based on available geophysical, geochemical, petrologic and modelling information. I'll outline how multi-disciplinary investigations of major eruptive events in the past 15 years has greatly improved this understanding and the eruption forecasting capability. Finally, I'll attempt to show how the lessons learnt on Mount Etna, as well as the methodologies used on this volcano, can have broad applications to numerous other volcanoes worldwide.

Nonlinear chlorinated solvent sorption and its impact on remediation in surficial sedimentary aquifers

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Contaminants stored in aquifer regions accessible only by diffusion produce 'tailing' in response to remediation wherein a rapid initial mass and/or concentration reduction is followed by sustained release at a low rate (or concentration). Our project combines laboratory experiments to parameterizing nonlinear sorption and intragranular diffusion with field scale simulations to explore the importance of contaminant sorption on tailing in surficial sedimentary aquifers.

The project examines chlorinated solvent behavior using trichloroethene (TCE) as our probe compound. The samples selected for study are kerogen-containing marine sedimentary rocks representative of the source rocks for surficial glacial aquifers in our region (southern Ontario, Canada and New York, USA). The equilibrium sorption isotherms collected spanned nearly five orders of magnitude in aqueous concentration. All samples showed nonlinear behavior with Freundlich isotherm slopes less than unity. Of the 11 candidate models common in the literature fit to the isotherm data, the dual-mode Polanyi-partition was the only model ranked as plausible for all of the samples via the corrected Akaike Information Criterion. We find that the best fit parameter sets for the three samples taken from a stratigraphic sequence in Ontario are consistent (within a factor of three) when the partitioning and sorption capacity parameters are normalized by the fraction organic carbon content. This finding is consistent with prior reports that document greater isotherm nonlinearity for more condensed carbonaceous matter.

Ongoing experiments are documenting TCE uptake and release rates to granular samples that are modeled as intragranular diffusion retarded by nonlinear sorption. Projection to plume scale transport and remediation through simulation shows that the influence of nonlinear sorption and/or pore diffusion is variable and sensitive to the combination of aquifer material (sorption characteristics and particle size) and plume history (age).

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