Contribution and effects of the volcanic carbon dioxide over the urban area of Naples

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The city of Naples is nearest to the Solfatara crater (Campi Flegrei caldera) that is a prodigious source of natural CO_2 [1]. In this study, the CO_2 plume dispersion is simulated using the DisGas code [2], under the most significant local-scale wind and hydrodynamic conditions of the atmosphere. Results showed that the western quarters of the city, as well as the inhabited area around the Solfatara, are mantled by the volcanic plume when atmospheric circulatory patterns are dominated by the common winds blowing from the sea. Under these conditions the CO_2 content in the air increases above normal values, reaching more than one thousand ppm in proximity to the Solfatara crater to a few tens of ppm several kilometres from the source (Figure 1). Simulated values satisfactory agreed with CO_2 concentrations measured by two stations inside the crater. A complete discussion of these results is presented elsewhere [3].

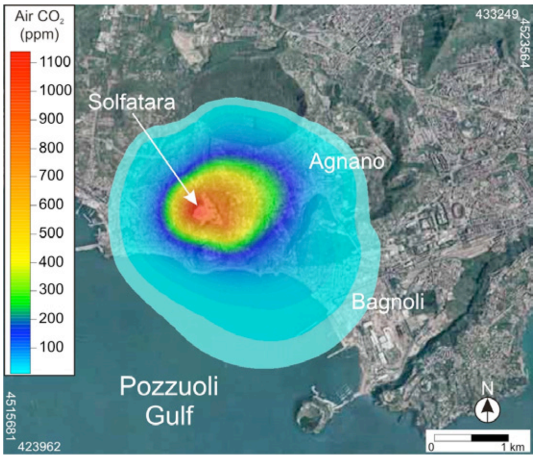

Figure 1: CO_2 plume dispersion over Naples. The concentration is expressed as values in excess of background CO_2 level.

[1] Chiodini *et al*. (2010) *J. Geophys. Res*. **115** (B03205), 531-542. [2] Costa *et al*. (2005) *An. Geophys*. **48** (4/5), 805-815. [3] Granieri *et al*. (2013) *J. Volcanol. Geotherm. Res*. **In press**.

The kinetic effects of H_2O in metasomatic and xenolith breakdown reactions

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The role of fluids, specifically water, in mineral replacement reactions has long been noted. Water is a vital catalyst as it lowers activation energies for reactions and increases solubilities of components for transport. The kinetic effects of fluids have been studied for solid-solid and solid-fluid reactions applicable to metamorphism but little attention has been paid to solid-melt reactions involved in metasomatism and xenolith breakdown in parent melts. We take the natural examples of olivine xenocryst breakdown in phonolite melt to form phlogopite rims and re-create these experimentally. Rim growth is parabolic with time, indicating diffusion limited reaction rates. No diffusion profiles are observed in the olivines or the melt suggesting transport via grain boundaries is rate limiting.

As the total water content is below the saturation threshold of the melt there should be no fluid phase in the system. However, addition of water to the melt significantly increases rates of reaction. This could be linked to changing transport porperties of rim grain boundaries at different levels of fluid saturation. We use Dual Beam (FIB + SEM) serial sectioning to observe 3D microstructures of the rims as well as TEM to determine the presence of pores in the reaction rims. The results of this show that free fluid forms in localized regions at the micron to submicron scale and that these are not well connected. The correspondence of water content in the melt with rim growth kinetics suggests that the grain boundaries become increasingly hydrated but not completely fluid saturated. This increases the transport of components through the rims, allowing faster growth rates.

The amount of fluid present in reactions of this kind will affect the rates of xenolith breakdown which are commonly used to assess residence times and ascent rates of magmas. The kinetic and transport properties of grain boundaries during melt infiltration and reaction during metasomatism will also be strongly influenced by the levels of fluid saturation, even if the bulk melt remains water-undersaturated. Understanding the affects of fluid saturation in grain boundaries is therefore vital.

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