Carbon dioxide and methane gas emanations of volcanic and natural areas in central Italy

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Carbon dioxide and methane are two important greenhouse gases which originate from biological, geological and anthropogenic sources. In the global methane budget reported by the International Panel on Climate Change little emphasis has been given to geological fluxes. However, on a regional Italian scale, geological CO$_2$ and CH$_4$ emissions might have comparable or even more relevant role than biogenic sources. For CO$_2$ most of the natural ecosystems, in fact, behave as sources and sinks depending on the season, with an annual net balance which can be often negative (CO$_2$ sink). CH$_4$ fluxes from Italian natural areas are generally negative (soil biological oxidation) and CH$_4$ emissions are only observed in anaerobic environments such as wetlands and rice paddies, which have a very limited surface in Italy. On the other hand, the Italian region is characterized by a high frequency of geothermal and volcanic areas which might produce significant amounts of the two greenhouse gases. While the role of biogenic sources in the global C budget is well characterized, less data are available for geological CO$_2$ fluxes and even fewer studies exist for CH$_4$, and more research is needed to widen the current database. In the present study CO$_2$ and CH$_4$ budgets have been estimated in three areas of central Italy, two volcanic (Cava de’ Selci and Solforata of Pomezia) and one natural (Solforata of Nepi). CO$_2$ and CH$_4$ fluxes were measured over a specifically designed grid, using two different techniques. CO$_2$ fluxes were obtained by an infrared gas analyzer coupled with a dynamic closed chamber. CH$_4$ fluxes were estimated by using static closed chamber and gas chromatographic analysis (FID).

In the three areas we measured not only fluxes for both carbon dioxide and methane, but we also measured the content and the CH$_4$/CO$_2$ ratios. The collected soil gases
were then compared with the same species, contents and ratios, obtained from “fumaroles” emanations and atmosphere in each site, in order to distinguish two “homogeneous” source regions.

Gases from each area where also analyzed for their isotopic content for He, Ar and $\delta^{13}\text{CO}_2$. This measurements result necessary to understand the origin of this gas emanations and the tectonic environments where these areas were formed.