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Rapid olivine and pyroxene weathering in volcanic plume during the Mount Etna pyroclastic activity (2001)

Loredana Antonella Randazzo (1,3,4), Sergio Andò (2), Paolo Censi (1,3), Pierpaolo Zuddas (3,4), and Eduardo Garzanti (2)

(1) Università di Palermo, Dipartimento C.F.T.A., Via Archirafi, 36 PALERMO, Italy, (2) Dipartimento di Scienze Geologiche e Geotecnologie, Università di Milano-Bicocca, Piazza della Scienza 4 20126 Milan, Italy, (3) IAMC-CNR, UOS di Capo Granitola, Via faro 1, 91026 Torretta Granitola, Campobello di Mazara (Tp), Italy, (4) Department Sciences de la Terre, UMR5125, Université Claude Bernard Lyon 1, 2 rue R. Dubois, Bat GEODE 69622 Villeurbanne Cedex (France)

Mt. Etna is the most active volcano in Europe and a continuous source of pyroclastic products. In summer 2001 began the most spectacular Etna's eruptive activity in the last 300 years producing an impressive eruptive plume with several million of m3 of volcanic ejecta. Samples of ash collected during the falling of pyroclastic material were separated with sodium metatungstate. Heavy and light fractions have recovered and mounted on slides for optical observations. Selected olivine and pyroxenes were hand-picked and mounted on a stub to Scanning Electron Microscopy observations. On the same minerals Raman spectra spectrum analysis were carried out, both to confirm their chemical nature and to analyse the possible relationship between crystallographic orientation of different faces and dissolution features.

Observations at different scales reveal, on selected minerals surfaces, the presence of common corrosion features such as grooves, each pits and irregular shapes with signs of favoured dissolution on particular areas. Chemical analyses carried out by Raman and EDS, confirm the chemical nature of olivine and augite and highlight an intense weathering on particular crystals faces, according to specific crystallographic direction, that is parallel to c axes, in correspondence of cleavages and rim intersection. In particular we have observed well developed etch pits and saw termination in clinopyroxenes, mainly on (001) and (111) faces. Moreover clinopyroxenes have got smooth or not so deeply corroded surfaces on the prismatic faces: (100);(110);(010). Olivines have shown a deeply corrosion on oblique faces respect the c axis and well preserved surfaces, without signs of corrosion, on the prismatic faces parallel to c axis.

We interpret these structures as index of chemical and physical alteration processes whose minerals are subject in the volcanic plume, before interaction with seawater or weathering on land. In particular there are clear dissolution features in minerals sites where cations (Ca^{2+} and Mg^{2+}) can be easily extracted by Cl^- and F^- into the plume and where cleavages interact, that is in (001) face, in which we can see typical alteration forms such as "sawteeth". The alteration process is thus anisotropic since minerals are undergone to a selective attack on their surface.

Knowledge about morphological and chemical features and the dissolution degree of minerals just after their emission, takes a relevant importance if we consider the following environmental dynamics, such as minerals-seawater interactions. In fact it allow us to well understanding the minerals dissolution behaviour and the following trace metal release in marine system.