Chapter 8

CONCLUSIVE REMARKS

The main aim of this work has been to underline the importance of the textural and compositional variations plagioclases can display and the use of them to investigate the feeding system on an active volcano such as Mount Etna.

The set of samples to which this work is referred include rocks from the eruptive events of 1669, 1763, 1766, 1886, 1892, 1983, 1985, 2001, 2002-2003, 2004 and 2006. It has been proposed a systematic classification of plagioclase textures based on optical microscopy and SEM imaging. Observations have been integrated with in-situ chemical analysis by SEM-EDS and EMP. The classification differentiated textures of crystal cores and of the rims. Resorption or dissolution textures at the cores have been interpreted as changes in the chemic-physical conditions, which might be associated to variation of pressure due to upwards H_2O-udersaturated magma migration. The scarcity of patchy textures in recent lavas could indicate that the associated magmas had minor volatile content dissolved or a minor ascent rate. Oscillatory zoning is frequent and has been interpreted as crystallization in a convective regime due to processes at the crystal/melt interface or, when dissolution surfaces and angular edges occur, as minor changes in chemical-physical parameters during convection.

Resorption and fast growth texture recognized at crystal rims can be used to infer the trigger mechanism of eruptions. Resorbed dusty rims are frequent and testify that a mixing with a more mafic terms triggered eruptions. On the other hand fast growth textures, as alignments of melt inclusions, suggest a tectonic control on eruption mechanism.

MELTS simulations has been used to determine the plagioclase stability field in a mantle re-equilibrated magma. Simulations show that plagioclase start to crystallize in a H_2O undersaturated magma from 250 Mpa (1-2 wt% H_2O). These results indicate that plagioclase stability is increased in undersaturated magmas and therefore only a limited amount of plagioclase crystallize at depth, whereas the large part of plagioclases nucleate and grow at superficial and/or in syn-eruptive conditions as water is lost during degassing.

The paradigm found and described above has been applied to the interpretation of the magmatic evolution of the eruptive period 2001-2006, allowing to set some constraints on the feeding system. Plagioclase cores indicate that magma batches can intrude in the shallow portion of the feeding system (between 6 and 3.5 km of depth below the summit craters) and reside for several months before the eruptive event. These magmas are remobilized in the first

phases of eruptions and mixed with more basic and volatile rich melts ascending during the eruptions. This will originate highly explosive eruptions (2001, 2002/2003, 2006). Mixing may also take place with melts, which can be more degassed and very likely associated to the central conduit feeding system such as the (2004).

The application of the paradigm at the 2001 eruptive event, suggests that mixing with a basic magma might have enhanced amphibole destabilization, which brought a conspicuous amount of water and contributed to increase the explosivity of the eruption, but also promoted plagioclase dissolution in the surrounding melt.

Plagioclase cores with dissolution features presented the same composition in the products of the two magmas erupted on the north and south sides of Etna during the 2002-2003 event, thus letting us to infer their common origin at depth. On the other hand, differently anotrthite-rich rims indicate that eruption was tectonically controlled at the NE Rift, while several magma input continued to alimented the activity on the S Rift.

Textural observations for 2004/2005 event have demonstrated that eruption were initially alimented by a shallower magma batch sited from 3-5 km depth below the summit craters, probably intruded during the final phases of 2002/2003 eruption. A degassed more mafic magma mixed with the first and alimented the event.

Finally, plagioclase indicated a volatile rich magma mixed and alimented the November 16th 2006 event.

Factors determining the dynamics of an eruption and the evolution of a magmatic system are a large number, here the focus is put on the plagioclases, which being ubiquitous in all lavas and in most volcanoes of our Planet offer certainly an interesting potential for being elected as testimonials of some of these processes. The textures uncovered and studied are many as many are the variables involved in the dynamics ascent and eruptions. However, the effort devolved in this work has reduced greatly the possibility, offering a concentrated spectrum of processes, which should be better investigated in future works for better understanding the evolution of the magmatic system and the relationships with the eruptive behavior of a persistently active volcano such as Mount Etna.