INTRODUCTION

During the last decades Mount Etna activity attracted the attention of the scientific community due to a several spectacular eruptions, showing a span of different eruptive styles. On 2001 and 2002/2003 were lateral events; activity was anomalously explosive and mainly concentrated on the South East summit crater and on the two lateral rift systems of South (South Rift System-SRS) and North East (North East Rift System-NERS). On the contrary, event of 2004 was only effusive and concentrated at the eastern part of the Valle del Bove. The following 2006 event was peculiar due to the high lava fountaining from the South East Crater interrupted by its lateral collapse and subsequent generation of a little pyroclastic flow on November 16$^{Th.}$

The study of the collected lava and tephra samples reveals some important textural and mineralogical differences, which suggest that the feeding system permits polybaric crystallization at several crustal levels during ascent and frequents episodes of magma mixing before the eruptions. In this contest, whole rock compositions could not be able to preserve the record of the complex differentiation processes, of magma mixing and of the chemical changes induced by crustal contamination.

On the other hand, *in situ* investigations on phenocrysts zoning in volcanic rocks have been proved to be a powerful tool for understanding differentiation processes within magma chambers (e.g., Davidson et al., 1991; Davidson and Tepley, 1997; Davidson et al., 2007; Ginibre and Wörner, 2007; Salisbury et al., 2008). Minerals can be highly sensitive to gradual or sudden modifications of the volcanic system, and can record changes of thermodynamic equilibria in their textural and compositional zoning patterns, depending on the process they underwent. The growth history of crystals can therefore be interpreted in order to recognize which process drove the magmatic system towards new physical and chemical equilibrium conditions, such as recharging of fresh magma, volatile input/loss or ascent-related

decompression. Specifically, several works have pointed out that textural and chemical zoning particularly of plagioclase may be an efficient tool for constraining the dynamics and kinetics of magmatic processes, chiefly due to its high sensitivity to changes in pressure and volatile contents of the system (e.g., Lofgren, 1980; Smith and Lofgren, 1983; Tsuchiyama, 1985; Pearce et al., 1987; Nelson and Montana, 1992; Johannes et al., 1994; Singer et al., 1995; Nakamura and Shimakita, 1998).

Several authors consider the 1971 eruption as one among the most intriguing geochemical and volcanological benchmarks at Mt. Etna (Clocchiatti et al., 1988; Armienti et al., 1989; Condomines et al., 1995; Tonarini et al., 2001; Corsaro and Cristofolini, 1996; Tanguy et al., 1997; Viccaro and Cristofolini, 2008, and references therein). Significant changes in the frequency and rates of emission also occurred, joined to important petrological differences among magmas emitted before and after 1971, which resulted in a transition of the eruptive behaviour to more explosive (cf. Branca and Del Carlo, 2004). These geochemical and volcanological changes have been recently ascribed to the partial melting of mantle domains characterized by large metasomatic influxes through time, which produced volatile-rich magmas able to trigger highly explosive events, such as the 2001 and 2002-03 eruptions (cf. Viccaro and Cristofolini, 2008).

In this study, a systematic investigation on textural features of plagioclase embedded in Mount Etna lavas is presented for the first time. Plagioclase has been choose because is one of the most frequent mineral phase in Mount Etna's lavas, in fact it is present in all lavas of the volcano evolution, from tholeiitic basalts to trachites, constituting the great majority of phenocrysts mass. Plagioclase certainly crystallizes at shallower pressure respect to olivine and clinopyroxene, and due to its highly sensitivity on chemical-physical conditions in the magma, it is the most useful phenocrysts to investigate processes that occur in the upper portion of the plumbing system. A textures types classification is proposed on the basis of the characteristics observed by SEM imaging of both historic and recent lavas. Compositional

profiles of An and FeO has been performed by electron microprobe (EMP) and electron microscope equipped with micro-analytical energy dispersion system (SEM-EDS), with the aim to suggest a possible interpretation of the formation mechanisms of the observed textures. Laser ablation coupled with plasma mass spectrometry (LAM-ICPMS), has been done on the crystals of 2002/2003 eruptions, to investigate if textures was generated by chemical changes in the melts or by P-T-XH_2O variations.

A MELTS modelling has been performed on the most basic lava erupted on 2004/2005 event, re-equilibrated to primitive mantle equilibria adding the fractionated mineral assemblages with the aim to establish P-T conditions of Mt. Etna plagioclase at different amount of water content dissolved in the magma. The model based on textures interpretations and on plagioclase stability, has been applied on the 2001-2006 eruptive period, with the aim to put new constraints on the recent volcano feeding system.