Magmatic volatiles: five years back, five years forward

YOUXUE ZHANG

Dept of Earth and Environmental Sciences, the University of Michigan, Ann Arbor, MI 48109-1005, USA (youxue@umich.edu)

The field of magmatic volatiles has been advancing rapidly in recent years so that it is too daunting to look ten years back and ten years forward as often done before. This presentation will introduce some seminal progresses in the last 5 years on magmatic volatiles, and look forward.

As in many fields, major progresses are often made possible by improvement of analytical techniques. We have witnessed major advancement of SIMS and nanoSIMS instruments in the measurement of volatile elemental concentrations, as well as nonvolatiles. These techniques now surpass the microFTIR technique in detection limit, spatial resolution, easiness of sample preparation, and the ability to measure many elements, although FTIR is still often used for calibration for H_2O and CO_2. The progress has allowed the determination of H_2O and other volatile concentrations in lunar baslats (Saal *et al*., 2008), which opened doors for many exciting studies. In addition, ERD and Raman techniques have also become tools for quantitative measurement of H_2O.

Numerous recent studies of volatiles in lunar rocks have decimated the notion that Moon is dry and pushed water concentration in the lunar interior higher and higher (Saal *et al*., 2008; Hauri *et al*., 2011; Hui *et al*., 2013). Although Moon does not have an ocean and is depleted in many volatile elements such as Na and K compared to Earth, it now seems that lunar mantle contains similar amount of H_2O as the terrestrial mantle. These will have important implicaitons on the origin of Moon.

In addition, determination of predegassing magmatic volatile concentrations using melt inclusions have proliferated (e.g., Portnyagin *et al*., 2007; Johnson *et al*., 2008), and the plagioclase hygrometer has been "perfected" to allow measurements of predegassing magmatic H_2O content of slowly cooled rocks (Lange *et al*., 2009). As a result, large amount of data has been accumulated, providing answers to fundamental questions about subduction zone processes as well as mantle plumes. A newly developed and novel H_2O/Ce thermometer for subduction zone magmas is becoming a powerful tool (Plank *et al*., 2009).

Other advancements include: the important role of CO_2 in mantle partial melting, general viscosity models for dry and hydrous melts although major improvement is still necessary, bubble nucleation and degassing, oxygen isotope diffusion due to H2O diffusion, resolution of OH diffusivity, etc.