Recent advances in the fused silica capillary high-pressure optical cell for the study of geological fluids

I-MING CHOU

Sanya Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences, No. 62 Fenghuang Rd., Sanya, Hainan Province 572000, P.R. China (imchou@sidsse.ac.cn)

Geological fluids are essential agents for the transport of material and energy in many geological processes, including magmatic activities, hydrothermal and metamorphic reactions, and formation of minerals, ores, oil, and natural gases. Knowing the basic physicochemical properties of these fluids will enhance our ability for understanding or formulating models of geological processes.

For the study of geological fluids, many types of high-pressure optical cells have been constructed, including the hydrothermal diamond-anvil cell (HDAC) [1] and the fused silica capillary high-pressure optical cell (FSC-HPOC) [2]. The versatilities and capabilities of these types of optical cells were enhanced by the developments of associated *in-situ* micro-analytical methods, including Raman spectroscopy and synchrotron X-ray spectroscopy. Even though the construction of a new type of HDAC (type V) and associated temperature controlling system has extended our routine experiments to temperatures (*T's*) up to 1000 ºC at elevated pressures *(P's)* (> 1 GPa) [3], the use of HDAC suffers two major drawbacks: (1) Difficult to load fluid samples of known compositions; and (2) unable to measure the sample pressure directly. However, these limitations were eliminated in the use of FSC-HPOC; even though the applicable P and T ranges are much smaller (< 200 MPa and < 600ºC), the FSC-HPOC can still be used to study the fluids involved in many geological processes. Furthermore, the newly available heating-cooling stage (Linkam CAP500) [4], designed specifically for the FSC-HPOC, and the development of the "Hg-sealed" [5] and "capillary non-mixing" [6] methods, for studying fluid samples of known compositions in the FSC-HPOC, greatly improved our capabilities for quantitative and kinetic studies of geological fluids.

[1] Bassett et al. (1993) *Rev. Sci. Instr.*, **64**, 2340-2345. [2] Chou et al. (2005) in *Advances in High-Pressure Technology for Geophysical Applications*. Chapter 24, 475-485. Elsevier. [3] Li et al. (2013) *Geofluids*, **13**, 467-474. [4] Chou (2012) *EMU Notes in Mineral.*, **12**, 227-247. [5] Guo et al. (2014) *Fluid Phase Equil.*, **382**, 70-79. [6] Applegarth et al. (in press) *Appl. Spectr.*