CO_2 Standard for Raman Densimeter

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Delta, the interval between peak centers of CO_2 Fermi diad bands, has a positive relation with CO_2 density. Raman CO_2 densimeter using this positive relation can be useful to estimate original pressure conditions from natural fluid inclusions in crustal and mantle rocks. However, since an error of 0.1 cm^{-1} in delta causes, for example, errors of 0.2-0.6 kbar in pressure estimation at 1000 degree C, the geological application requires determination of delta with high accuracy. We have to get rid of minor systematic errors associated with Raman analyses, such as internal daily changes of Raman systems and inter-laboratory differences in mechanical configurations and methods of peak analysis.

Seven CO_2 standards are prepared at Geochemical Laboratory, the University of Tokyo. They are natural CO_2 fluid inclusions with standard values of delta (103.27 - 105.50 cm^{-1}) that satisfy a density-delta curve previously determined at the laboratory.

To estimate inter-laboratory errors and test the efficiency of CO_2 standard, measurements of unknown samples (CO_2 fluid inclusions in two granulite samples) and standards were carried out at five laboratories. Estimated correction values were independent of delta and vary significantly depending on the Raman systems (-0.06 cm-1 to -0.37 cm^{-1}). Corrected delta values of unknown samples (and corresponding density) are 104.60 cm^{-1} (0.89 g/cm^3) and 104.92 cm^{-1} (0.99 g/cm^3) in average. Inter-laboratory deviations are lower than +-0.06 cm^{-1} (0.03 g/cm^3) and +-0.02 cm^{-1} (0.01 g/cm^3), respectively.

These results confirm that Raman CO_2 densimeter can determine CO_2 density in fluid inclusions with an accuracy comparable to micro-thermometric measurements based on homogenized temperature. Standard delta can be easily calibrated at any laboratory with reference CO_2 and we can provide it on request with an appropriate CO_2 fluid inclusion. Correction using the standard is very simple. Use of Raman CO_2 densimeter with CO_2 standard has a potential to be a new popular method.