Correlations between the apparent interlayer spacings d002 and the Raman R2 parameters of carbonaceous matters in metamorphic rocks

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Interlayer spacings d002 of carbonaceous matters (CMs) in sedimentary rocks have long been used to investigate degrees of metamorphism. Itaya (1981) showed that the apparent d002 values decrease with increasing metamorphic grades along the Asemi river in the Sanbagawa metamorphic belt in Ehime Prefecture. Takami and Nishimura (2000) presented that the apparent values of CMs in the Jurassic Kuga Group tend to decrease toward the contact boundary with the Late Cretaceous Hiroshima granite in the Yasaka area, Hiroshima Prefecture. Chijiwa et al. (1993) also noted that the apparent values of CMs in the Miocene Susa Group decrease toward the contact boundary with the Pleistocene Koyama gabbro in the Susa area, Yamaguchi Prefecture. On the other hand, Beyssac et al. (2002) proposed a geothermometer based on the Raman R2 parameters of CMs, T ($^{\circ}$C) = -445 R2 + 641, and applied it for the temperature analyses in the Asemi area.

We have analyzed the Raman R2 parameters of CMs in rocks from the above three areas and compared them with the apparent d002 values reported in the above studies. Although standard deviations of the R2 parameters in individual rock specimens are large, the modal R2 parameters show good positive correlations with the apparent d002 values in the ranges R2 $\leq$0.75 and d002 < 3.60, while no clear correlation is shown out of the ranges (Fig. 1).

The correlation can be approximated by a simple hyperbolic equation, (R2 - a) (d002 - b) = k. Hence, we may estimate a metamorphic temperature in the above area from the previously reported apparent d002 value by combining the above two equations as T ($^{\circ}$C) = -445 (k / (d002 - b) + a) + 641. Asymptotic values for R2 (a) and d002 (b) and k for the all data in the above ranges are 0.95, 3.26 and -0.064, respectively, with R^2 as 0.94. On the other hand, those only for the Asemi area are 0.96, 3.28 and -0.058, respectively, with R^2 as 0.94, and for the Yasaka area are 0.89, 3.27 and -0.046, respectively, with R^2 as 0.97, while those only for the Susa area can not be obtained, since the most data are out of the ranges.

Since the geothermometer of Beyssac et al. (2002) is applicable for the range, R2 < 0.7, the parameter set of the Asemi area obtained from the data mostly within the range is better to take for practical temperature estimations.
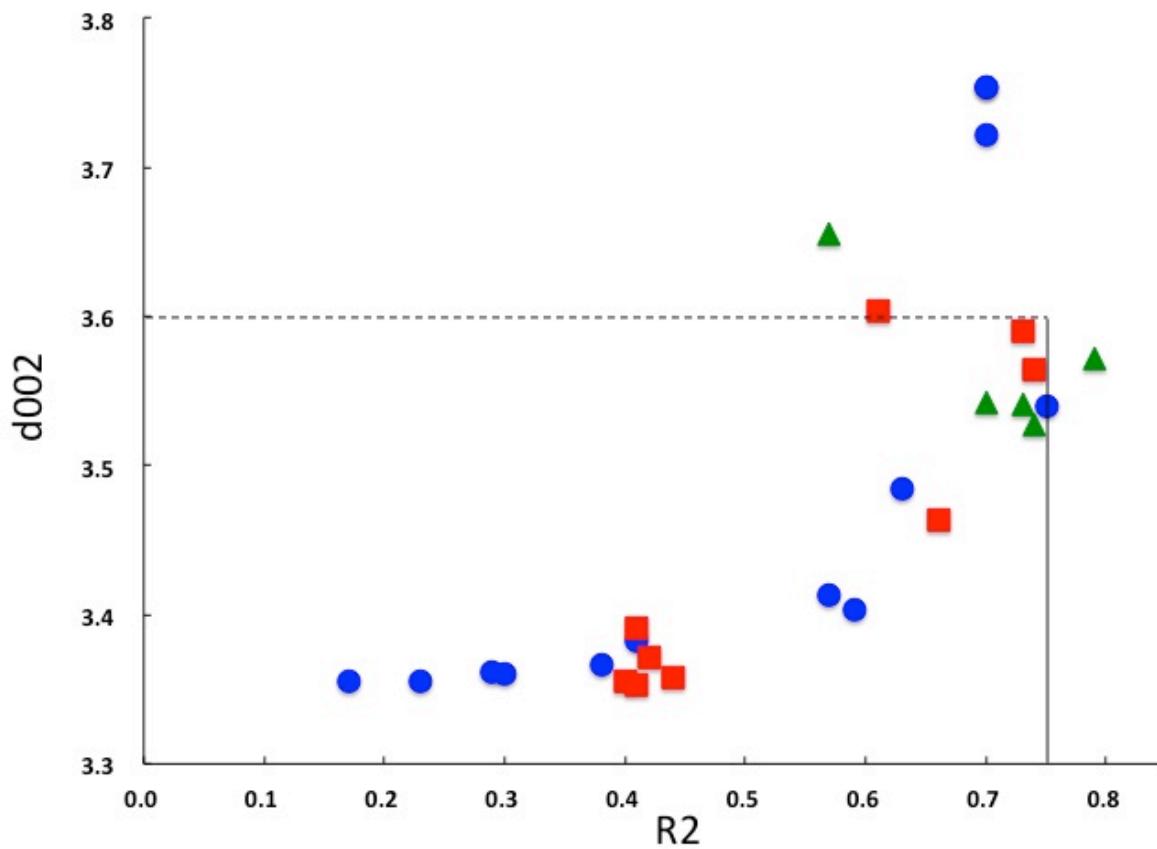
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Fig. 1 Correlations between d002 and R2 of CMs in the Asemi (circle),
Yasaka (square) and Susa (triangle) areas.