Acta Geologica Sinica (English Edition), 2019, 93(supp.2): 68–69

Study on the Conversion of Clay Minerals in the Fault Gouge of Shuiquanzigou-Tianshankou Fault

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Citation: Li et al., 2019. Study on the Conversion of Clay Minerals in the Fault Gouge of Shuiquanzigou-Tianshankou Fault. *Acta Geologica Sinica* (English Edition), 93(supp.2): 68–69.

Abstract: Fault gouge as a material recorder of the history of fault activity including age, pattern and physical condition (Ma et al., 1985; Lin et al., 1995; Ma et al., 2006), etc., is of great significance to study the history of fault. Clay minerals which are often the main component of fault gouge are increasingly considered as a key to understand brittle fault and fault zone processes (Haines and van der Pluijm, 2012). To study the characterization of fault gouge of Shuiquanzigou-Tianshankou fault, we sampled at Yangshulin Profile of this fault, and collected 6 groups of gouge samples with equal intervals in the parallel to the fault strike and fault plane. The clay mineralogy was examined at equal intervals of 0, 1, 2, 3, 4 and 5 (Fig. 1) from one side of the reverse fault gouge to the other side removed to avoid any contamination from surface weathering. The lithology and structures of fault gouge in the six samples collected at the designed intervals were then characterized by X-ray diffraction (XRD) for both bulk and clay-size fraction (<2μm) and high-resolution transmission electron microscopy (HRTEM). From this study, we can conclude that the minerals of fault gouge are mainly composed of clay mineral, quartz, plagioclase, limonite. Moreover, the content of clay mineral and quartz increased with the increase of sampling depth, while that of plagioclase and limonite decreased (Fig. 2). More specifically, the clay mineral in this fault gouge are dominantly by illite/smectite and the content of smectite layers is up to 70%-90% among them. Therefore, we could obtain the formation temperature of illite/smectite to be 100-150℃ through the calculation of the illite/smectite geothermometer built by Atsuyuki Inoue (Inoue et al., 2004) that would be supported from the thermometer of fluid inclusions in the subsequent study. The results highlight the clay mineralogical assembly in fault gouge and provide the primary parameters for the analysis of slight temperature rises caused by frictional heating on the I/S bearing faults. This method is potentially applicable to the faults in other tectonic settings.

Key words: fault gouge, illite/smectite, frictional heating

Acknowledgements: The authors are grateful to anonymous reviewers for their incisive reviews of the manuscript. This

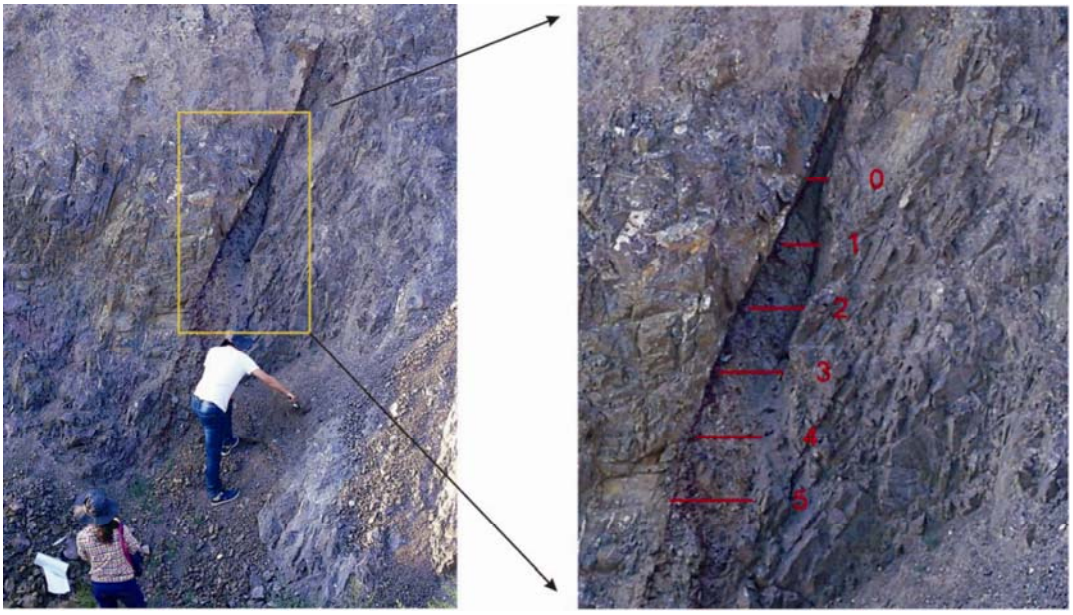

Fig. 1. Occurrence of the fault gouge showing the injection structure and the sampling intervals 0, 1, 2, 3, 4 and 5 for mineralogical analysis.

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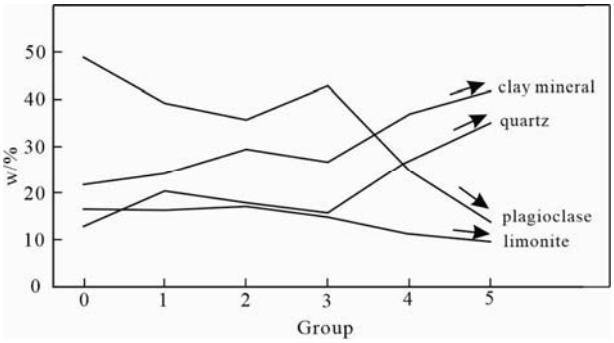

Fig. 2. The distribution of minerals in the samples.

research was supported by the National Youth Sciences Foundation of China (No. 41502044) and the opening foundation of State Key Laboratory of Inorganic Synthesis and Preparative Chemistry, College of Chemistry, Jilin University (No.2019-30).

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