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Is the Travertine on the Eastern Margin of the Qinghai-Xizang (Tibet) Plateau as a Surface Rock Record of the Lower Crustal Channel Flow?

WANG Fudong[1], DONG Faqin[1, *], ENRICO Capezzuoli[2] and ZHAO Xueqin[1]

[1] *School of Environment and Resource, Southwest University of Science and Technology, Mianyang 621010, Sichuan,China*
[2] *Department of Earth Science, University of Firenze, Firenze 50121, Italy*

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Abstracts: Although the Lower Crustal Flow (LCF) (Royden et al., 1997) pattern is still controversial in the study of the uplift dynamics in the eastern margin of the Qinghai-Xizang (Tibet) Plateau, however, geophysical data support this model, especially it can reasonably explain why such a large amount of energy accumulates deep in the eastern margin of the plateau while the surface deformation and movement rate are relatively low. The LCF is also considered to be a trigger for the intense seismic activity in the eastern margin of the plateau in recent years. It would be direct if some LCF information could be extracted from the rock record. However, the previous studies on Pengguan Complex and the intrusive rocks of Garzê Fold Belt are too weak to find any records of surface rocks (Zhang et al., 2004). Herein, we propose that the travertine on the eastern margin of the plateau is the best recorded rock of the LCF.

Travertine is supersaturated with calcium carbonate in water due to CO_2 emissions under appropriate physical, chemical or biological conditions, resulting in precipitation of calcium carbonate on different topography. The chemical equation is as follows: $Ca^{2+}+2HCO_3^-\Rightarrow CaCO_3+CO_2+H_2O$. The source of CO_2 is particularly important for the understanding of the genetic mechanism of travertine. Therefore, previous studies (Pentecost, 1995) divided the travertine into two categories: atmospheric and thermogenic travertine. The former CO_2 is drove by the degassing of the atmosphere and soil, and usually has a lower $\delta^{13}C$ (–12‰ ~ 2‰); the latter is mainly triggered by the degassing of CO_2 from deep mantle or metamorphic genesis, with $\delta^{13}C$ –1‰~10‰. For the thermogenic travertine, the deep-sourced CO_2 dissolves in the groundwater to form the karst water in the carbonate rock area, and then begins his karstification, then, the travertine is deposited by the discharge of CO_2 at the spring water. Thus, deep-sourced CO_2 provides a source of vitality for travertine, where requires a robust engine in the deep, and the LCF is a potential producer.

On the other hand, it carries, from the material properties of LCF, a heat source (depth of 45 ~ 72 km, corresponding to a temperature of 800 ~ 1100℃) (Lawet al., 2006), which is conducive to deep rock metamorphism and CO_2 removal; From the perspective of channel flow operation mechanism, the peristalsis towards the southeast of the plateau will be decoupled when it encounters rigid ground block. The stress caused by the upward decoupling causes the uplift of the eastern margin of the plateau to be deformed, accompanied by the formation of active structures; the downward decoupling thickens the crust or inserts into the upper mantle, which in turn can open the CO_2 channel of the mantle source. That is to say, whether decoupling up or down is beneficial to provide a path for CO_2.

It is precisely because of the existence of the LCF in the eastern margin of the plateau that the travertine in the region is linearly distributed along the northeast-southwest direction, e.g. the travertine output is consistent with the channel flow trajectory. The deposition of these travertines is a good record of the creeping information of the LCF, and the deep source of CO_2 extracted by Liu et al. (2003) in Huanglong and Baishuitai travertine arerobust evidences. Therefore, we believe that the thermogenic travertine of the eastern margin of the plateau is a direct record on the surface after the operation of the LCF.

Key words: Eastern margin of the Qinghai-Xizang (Tibet) Plateau, Lower crustalflow, travertine, Mantle sourceCO_2, Rock record

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References

Law, R.D., Searle, M.P. and Godin, L., 2006. Channel flow, ductile extrusion and exhumation in continental collision zones: an introduction. Geological Society, London, Special Publications, 268: 1–23.

Liu, Z., Zhang, M., Li, Q., You, S., 2003. Hydrochemical and isotope characteristics of spring waterand travertine in the Baishuitai area (SW China) and their meaning for paleoenvironmentalreconstruction. Environmental Geology, 44(6): 698–704.

Pentecost, A., 1995. The quaternary travertine deposits of Europe and Asia Minor. Quaternary Science Reviews, 14(10): 1005–1028.

Royden, L.H., Burchfiel, B.C., King, R.W., Wang, E., Chen, Z., Shen, F., Liu, Y., 1997. Surface Deformation and Lower Crustal Flow in Eastern Tibet. Science, 276(5313): 788–790.

Zhang, P.Z., Shen, Z.K., Wang, M., Gan, W.J., Roland, B., Peter, M., Wang, Q., Niu, Z.J., Sun, J.Z., Wu,J.C., Sun, H.R., Zhao, Y.X., 2004. Continuous deformation of the Tibetan Plateau from globalpositioning system data. Geology, 32(9): 809–812.

* Corresponding author. E-mail: fqdong@swust.edu.cn

About the first author

WANG Fudong, male, born in 1982 in Huili Country, Sichuan Province; doctor; graduated from Institute of Geochemistry, Chinese Academy of Sciences; lecturer of Southwest University of Science and Technology. He is now interested in the study on minerals, rocks and deposit geochemistry. Email: wolfdongswust@163.com; phone: 18281593798.

About the corresponding author

DONG Faqin, male, born in 1963 in Fufeng County, Shanxi Province; doctor; graduated from China University of Geosciences; professor of Southwest University of Science and Technology. He is now interested in the study on environmental science and engineering. Email: fqdong@swust.edu.cn; phone: 13980125273.