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金沙江南流入红河的锆石 U-Pb 年龄谱物源示踪研究的质疑

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摘　要：Ping Kong 等近期发表二篇文章,采用锆石 U-Pb 年龄谱物源示踪方法,研究得出古金沙江曾经石鼓南流入红河的结论,论文对此提出了质疑。测定 U-Pb 年龄谱的锆石粒度 > 0.25 mm,比重 4.5 g/cm^3 左右,为推移质,该技术只适用于较短距离的无湖泊河流的物源示踪研究。将第四纪沉积物和现代河流泥沙的锆石 U-Pb 年龄谱与大区域岩层的进行对比,分析泥沙来源,研究金沙江河流演化的技术路线存在根本性的缺陷。

关键词：物源示踪方法;锆石 U-Pb 年龄谱;金沙江
中图分类号：P597　　**文献标志码**：B

笔者近年来关注长江形成演化的研究,并有所思考[1]。金沙江是否曾经南流入红河,后被袭夺东流,是地理学界的热点问题[2-5]。Ping Kong 等最近采用锆石 U-Pb 年龄谱物源示踪方法,对这一热点问题进行研究,发表了《Provenance and time constraints on the formation of the first bend of the Yangtze River》[6] 和《Cosmogenic nuclide burial ages and provenance of the Xigeda paleo-lake: Implications for evolution of the Middle Yangtze River》[7] 两篇文章。依据锆石 U-Pb 年龄谱物源示踪研究,文献[6]认为,古金沙江从石鼓流经通甸(Tongdian)、马登(Madeng)、翠屏(Cuiping)和南涧(Nanjian)盆地入红河;文献[7]认为,鹤庆涛源以东的古金沙江不是东流,而是从攀枝花西流到涛源再南流经宾川盆地南流入红河(图 1)。

笔者最近多次考察金沙江,对文献[6 - 7]的结论不敢苟同。文献[6]中通甸、马登和南涧盆地的取样剖面砂砾层的颜色为灰白和灰红色各异(图 2)。金沙江堰塞湖主体细粒泥沙(细、粉沙,黏土)沉积,颜色均为灰黄色(下部深湖相为深灰色),如石鼓、涛源、攀枝花和巧家等地的金沙江堰塞湖沉积。笔者实地察看了通甸和马登取样剖面,绝不是金沙江大河沉积,而是滑坡或泥石流阻塞形成的小型山间盆地湖沼相的含泥角砾层、砂层互层沉积,因此不同盆地的沉积物颜色不尽相同。既然通甸、马登、翠屏和南涧盆地沉积不是金沙江大河沉积,何谈通过这些盆地沉积泥沙与区域岩层的锆石 U-Pb 年龄谱对比,得出金沙江曾经流经这些盆地进入红河的结论? 文献[7]的涛源堰塞湖沉积,湖首涛源一带为厚达百米的灰黄色粉、细、黏土层,向上逐渐变粗,湖尾中江一带以细砾、粗沙为主(图 3);攀枝花一带的昔格达堰塞湖沉积,湖中心昔格达一带也为厚达百米的灰黄色粉、细、黏土层,向上逐渐变粗,湖尾格里坪一带昔格达组下部砾石层大量出现(图 4)。显然,当时金沙江的流向与现在一致,中江 - 涛源 - 攀枝花东流。通过涛源堰塞湖沉积泥沙和现代河流泥沙与大区域岩层的锆石 U-Pb 年龄谱对比,得出的金沙江曾经从攀枝花西流到涛源再南流,

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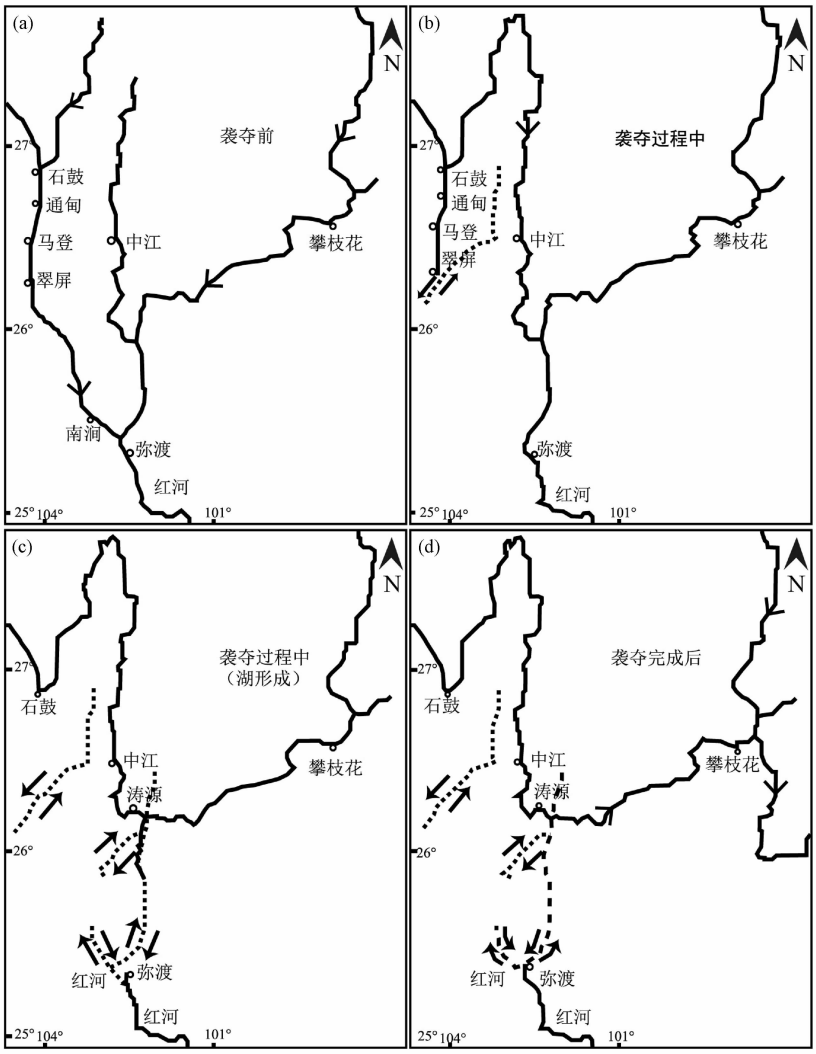

图 1 金沙江中游的裘夺与倒流示意图以及文献[6]的 4 个 U-Pb 年龄谱取样盆地(据文献[6－7]修改)

(a)古金沙江西支(石鼓)和东支,南流在弥渡附近汇入红河;(b)古金沙江西支被裘夺东流;(c)古金沙江东支被裘夺过程中(攀枝花－中江之间存在湖泊);(d)裘夺完成后的金沙江(现今)

Fig. 1 Capture and reversal of the Middle Yangtze River, and 4 sampling basins with the zircon U – Pb age as referred in the reference [6]. (modified according to references [6－7]): (a) The upstream of the Yangtze River was dammed by the left slip of Heqing fault; (b) The stream from Zhongjiang-Taoyuan to Bichuan was dammed by the right-lateral slip of Huaqiao fault accompanied by a normal dip slip; (c) The drainage channel from Panzhihua-Bichuan to Midu was dammed by the left slip of Chenghai fault; (d) Water eventually cut through a spillway in the east, and the Yange Yangtze River flows east

经宾川盆地南流入红河的结论是不可信的。

Ping Kong 利用锆石 U-Pb 年龄谱物源示踪技术,得出的金沙江曾经南流的结论不成立的原因何在? 笔者认为主要是锆石 U-Pb 年龄谱物源示踪技术适用性。这一技术基本原理不存在问题,是泥沙物源示踪的好技术。但是,测定年龄谱的锆石粒度 >0.25 mm,比重 4.5 g/cm^3 左右,硅酸盐泥沙的比重 2.65 g/cm^3 左右,为推移质。对河湖系统而言,推移质泥沙多沉积于湖盆,只有悬移质(<0.01 ~ 0.05 mm)泥沙流入湖盆下游的河流。这就是说,该技术只适用于较短距离的无湖泊河流的物源示踪研究,不适用于有湖泊存在的河流的物源示踪研究。将第四纪沉积物和现代河流泥沙的锆石 U-Pb 年龄谱与大区域岩层的进行对比,分析金沙江河流泥沙来源的技术路线存在根本性的缺陷。文献[6]的通甸、马登、翠屏和南涧等 4 个山间小盆地沉积物泥沙具有相似的锆石 U-Pb 年龄谱,应有其他的解释[8]。推移质的搬运距离是有限的,文献[7]的攀枝花－

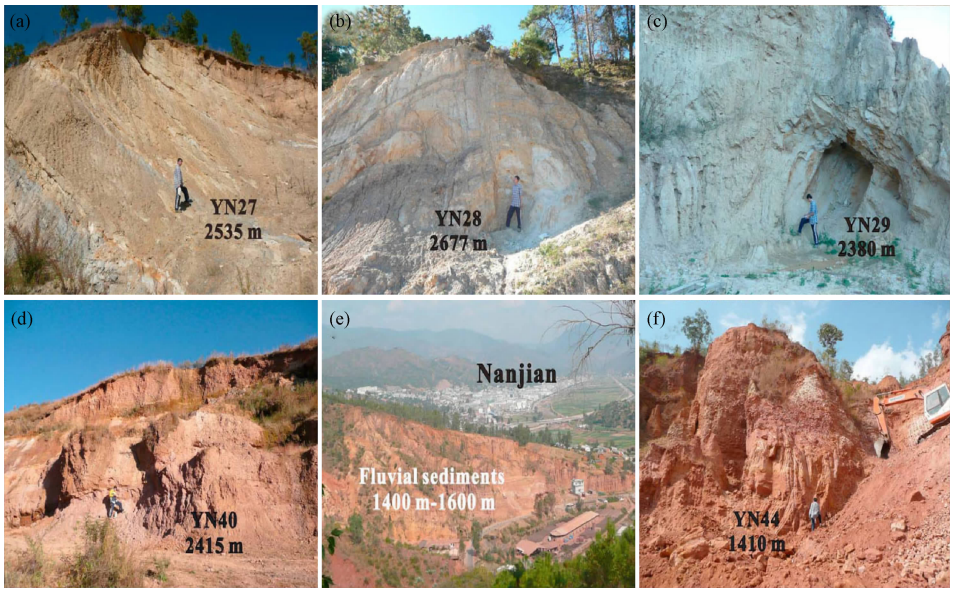

图 2　用于 U-Pb 年龄谱和宇生核素断代用的河流相砂样采样剖面

通甸(a)~(c);马登(d);南涧(e)~(f);通甸灰白色沙层,马登和南涧灰红色沙、砾石互层(文献[6],Fig. 3)

Fig. 2　Collected fluvial sand samples at Tongdian (a) ~ (c), Madeng(d) and Nanjian(e) ~ (f). These samples were used for zircon U-Pb age estimation and cosmogenic nuclide burial dating. The sands at Tongdian were gray-white colored, whereas interbedded sands and gravels in Madeng and Nanjian were reddish in color

图 3　涛源堰塞湖的沉积剖面:(a)湖首(涛源);(b)湖尾(中江)

Fig. 3　The sedimentary profile of the dammed Taoyuan lake:(a)the head at Taoyuan and (b)the tail at Zhongjiang

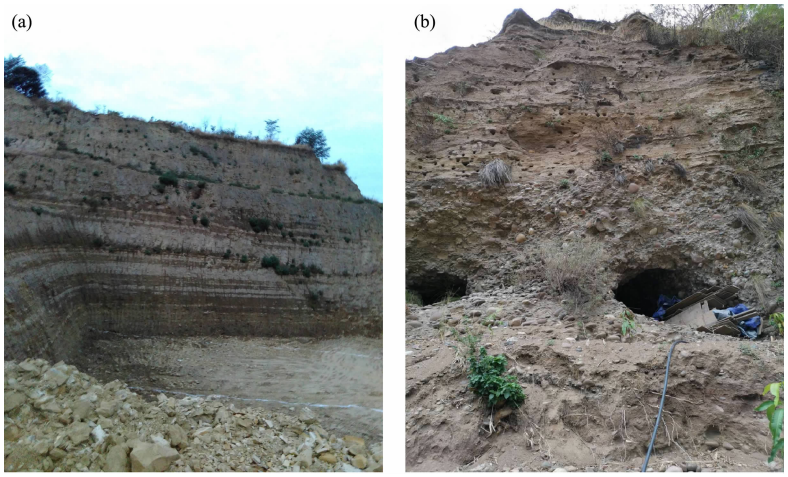

图 4　昔格达堰塞湖的湖首(a,昔格达)和湖尾(b,格里坪)沉积剖面

Fig. 4　The sedimentary profile of the dammed Xigeda lake at (a)the head(Xigeda) and (b)the tail(Geliping)

涛源不同河段的湖相沉积物和现代河流泥沙的锆石U-Pb年龄谱存在差异是正常的,金沙江曾经从攀枝花西流到涛源的结论是不成立的,违反了地貌学和沉积学常识。

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Question of Using the Zircon U-Pb Age Technique for Sediment Tracing to Study Whether the Ancient Jinsha River Flew Southward to Joint Red River

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Abstract: In this paper, a hypothesis was challenged, of which the ancient Jinsha River used to flow southward at Shigu, not eastward as present, to joint the Red River, which was asserted in Ping Kong's two papers by using the zircon U-Pb age for sediment tracing. It is well known that the zircon mineral grains for U-Pb age analysis are narrowly applicable to bed-loading sediment. This is because the particle sizes for U-Pb age analysis are usually greater than 0.25 mm and their density is about 4.5 g/cm^3; therefore, the technique is only suitable for sediment tracing with a relative short transportation distance in rivers other than those in lakes. The technique has fundamental deficiencies for a study of the Jinsha river evolution by merely comparisons of the zircon U-Pb ages of the sands between quaternary or present river sediments and regional rocks in a large area.

Key words: zircon U-Pb age; sediment tracing; Jinsha River