Discovery of the Fuyan teeth: challenging or complementing the out-of-Africa scenario?

Yu-Chun LI, Jiao-Yang TIAN, Qing-Peng KONG

Although it is widely accepted that modern humans (*Homo sapiens sapiens*) can trace their African origins to 150-200 kilo years ago (kya) (recent African origin model; Henn et al, 2012; Ingman et al, 2000; Poznik et al, 2013; Weaver, 2012), an alternative model suggests that the diverse populations of our species evolved separately on different continents from archaic human forms (multiregional origin model; Wolpoff et al, 2000; Wu, 2006). The recent discovery of 47 teeth from a Fuyan cave in southern China (Liu et al, 2015) indicated the presence of *H. s. sapiens* in eastern Eurasia during the early Late Pleistocene. Since the age of the Fuyan teeth (80-120 kya) predates the previously assumed out-of-Africa exodus (60 kya) by at least 20 kya, this inconsistency provides some support for the multiregional origin model, and thus may challenge the recent African origin hypothesis.

If the Fuyan cave individuals were derived from archaic humans in eastern Eurasia and evolved into the contemporary modern populations that resided in the region, as suggested by the multiregional origin model, a closer morphological relationship or even successive morphological characteristics between the Fuyan teeth and *Homo erectus* from eastern Eurasia should be observed. Unfortunately, metric assessment of the teeth samples shows that Fuyan individuals differ morphologically from the Asian *H. erectus* (Liu et a, 2015), and therefore it is unlikely that they evolved from the local *H. erectus* populations (Dennell, 2015). Instead, the close affinity between Fuyan teeth and European Late Pleistocene samples and contemporary humans indicates that Fuyan man derived from common ancestors of modern humans, thus lending further support to the recent African origin model.

Nevertheless, the early Late Pleistocene occupation of Fuyan man in eastern Eurasia raises another question on how early our ancestors dispersed from Africa and successfully colonized eastern Eurasia. Based on the ages of modern human fossils in the Middle East (Skhul and Qafzeh in Israel, about 100 kya; McDermott et al, 1993; Millard, 2008; Smith et al, 2010), it is believed that the exodus from Africa started about 100 kya and reached eastern Eurasia about 74 kya before the eruption of the Toba volcano (Petraglia et al, 2007). However, genetic evidence (mainly from mitochondrial genomes) suggests that the initial settlers left Africa approximately 60 kya and then rapidly dispersed into eastern Eurasia *via* a southern coastal route about 40-60 kya (Macaulay et al, 2005; Sun et al, 2006). The lack of human fossils dating earlier than 70 kya in eastern Eurasia implies that the out-of-Africa immigrants around 100 kya likely failed to expand further east (Shea, 2008). Consistent with this notion, the Late Pleistocene hominid records previously found in eastern Eurasia have been dated to only 40-70 kya, including the Liujiang man (67 kya; Shen et al, 2002) and Tianyuan man (40 kya; Fu et al, 2013b; Shang et al, 2007) in China, the Mungo Man in Australia (40-60 kya; Bowler et al, 1972), the Niah Cave skull from Borneo (40 kya; Barker et al, 2007) and the Tam Pa Ling cave man in Laos (46-51 kya; Demeter et al, 2012). Furthermore, although the Zhiren cave man (~110 kya) in southern China was suggested to represent the earliest Late Pleistocene hominid in this region (Liu et al, 2010), later research indicated it would be more appropriately assigned to *H. erectus* (Dennell, 2010). In this regard, the evident *H. s. sapiens* morphological characteristics of the Fuyan teeth provide strong evidence supporting that the occupation of early modern humans in eastern Eurasia could be traced back to the early Late Pleistocene. [1]

One explanation for this early colonization could be that our ancestors dispersed out of Africa more than once. Hitherto, the issue on how many successful dispersals occurred from which our ancestors colonized eastern Eurasia is still contentious. Previous evidence from mitochondrial DNA (mtDNA) and archaeological studies suggests that modern humans dispersed into eastern Eurasia very rapidly *via* the coastal route only once (Kivisild et al, 2006; Macaulay et al, 2005; Mellars, 2006; Watson et al, 1997). This “single dispersal model” has been challenged by the “multiple dispersal model” proposed by whole nuclear genome study on the aboriginal man from southern Western Australia (Rasmussen et al, 2011). Since the upper boundary of the first dispersal time (75 kya; Rasmussen et al, 2011) is very close to the estimated date of Fuyan man, it is likely that Fuyan man were from the first settlers on the eastern Eurasian continent. Additionally, the gap of 20 000 years or

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Dr YC LI, Miss JY TIAN and Dr QP KONG are at the State Key Laboratory of Genetic Resources and Evolution at the Kunming Institute of Zoology, Chinese Academy of Sciences. E-mail: kongqp@mail.kiz.ac.cn

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more between the Fuyan teeth and the potential second dispersal based on the estimated divergence of European and East Asian lineages (60-25 kya; Soares et al, 2009; Rasmussen et al, 2011; Behar et al, 2012) seems to favor at least two separate out-of-Africa dispersals of early modern humans.

One should be extremely cautious, however, as the dating gap could also be attributable to the lack of human records in that time frame or uncertainties in mutation rates of the genetic markers under study or methodologies adopted in time estimation (Fu et al, 2013a; Rieux et al, 2014; Scally & Durbin, 2012). In fact, with the revised mutation rates, recent studies have proposed that the out-of-Africa exodus likely started at approximately 62-130 kya (Fu et al, 2013a; Rieux et al, 2014; Scally & Durbin, 2012), while the European and Asian split occurred at about 40-93 kya (Fu et al, 2013a; Scally & Durbin, 2012), much earlier than the previously estimated dates. More intensive studies on the mutation rates of both nuclear genomes and mtDNA are crucial to resolve these inconsistencies. It is noteworthy that even if modern humans migrated out of Africa more than once, whether the Fuyan population genetically contributed to the contemporary eastern Eurasians, or whether later immigrants from the second dispersal completely replaced the Fuyan individuals remains to be investigated. Information from the ancient DNA buried in the teeth samples will be of great help to answer these questions and then shed more light on the prehistory of our species.

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