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A “source and sink” model for East Asia? Preliminary approach through the dental evidence

*Un modèle de « source et écoulement sans fond » pour l'Est asiatique ?
Approche préliminaire à partir des données dentaires*

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ABSTRACT

This study aims to present a preliminary approach to the suitability of the “source and sink” model (Bermúdez de Castro and Martinón-Torres, 2013; Dennell et al., 2011) to explain the human settlement of East Asia. We present a general overview of the hominin dental evidence with a special emphasis in some key localities with human remains that have been recently described. Our analysis suggests that the morpho-dimensional variation of the Pleistocene populations from East Asia cannot be accommodated within one single lineage. This evidence seems supportive of an intense but also more discontinuous pattern of occupation. The severe climatic oscillations, the extent of the desert areas and the possibility of intermittent exchanges between continental and insular East Asia, depending on sea level changes, are key factors to identify possible sink and sources in the region. Future studies should focus in a large-scale characterization of the Asian hominins in order to identify morphologically coherent groups and to understand the evolutionary story behind their spatio-temporal distribution.

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RÉSUMÉ

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L'objectif de cette étude préliminaire est de tester la possibilité de proposer le modèle « source et écoulement sans fond » (Bermúdez de Castro and Martinón-Torres, 2013; Dennell et al., 2011) pour expliquer le peuplement humain de l'Asie de l'Est. Nous présentons un panorama général de l'évolution dentaire des hominins et, de façon plus détaillée, quelques localités incontournables ayant livré des restes humains que nous avons décrits récemment. Notre analyse suggère que la variation morphométrique des populations pléistocènes de l'Est asiatique peut totalement s'inscrire au sein d'une seule lignée. Ce phénomène semble dû à une intensité, mais également à une discontinuité, de peuplement du territoire.

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Les oscillations climatiques rigoureuses, l'extension des zones désertiques et la possibilité d'échanges par intermittence entre l'Est asiatique continental et insulaire en fonction des changements du niveau marin sont des facteurs déterminants pour identifier de possibles sources et écoulements dans cette région. De futures études devront se focaliser sur la caractérisation à grande échelle des hominins asiatiques, dans le but d'identifier des groupes morphologiquement cohérents et de comprendre l'histoire évolutive à travers leur répartition spatio-temporelle.

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Recent studies have emphasized the significant morpho-dimensional variation of the Pleistocene populations from East Asia. The detailed analysis of dental samples such as those from Xuijiayao, Panxian Dadong, Hexian, Chaoxian, Zhoukoudian or Sangiran (e.g., Bailey and Liu, 2010; Kaifu, 2006; Liu et al., 2013; Xing, 2012; Xing et al., 2015; Zanolli, 2013) reveal that the variability of the East Asian hominin populations is larger than previously thought. Characterising the morphology and spatio-temporal distribution of the Asian hominins would be a critical contribution to the current debate about the pattern of hominin settlement in Asia. Currently, opinions in this topic range from the proposal of a continuous and flourishing occupation (e.g., Ciochon and Bettis, 2009; Keates, 2010; Zhu et al., 2004), based on supposedly benign climatic conditions (Ao et al., 2010; Pei et al., 2009), to the suggestion of a discontinuous and more intermittent settlement of Asia (Dennell, 2009, 2013a, 2013b; Louys and Turner, 2012).

Interestingly, the history of the discussion about the settlement of Asia goes in parallel with the latest research on the Middle Pleistocene of Europe and the origin of *H. neanderthalensis* (e.g., Arsuaga et al., 2014; Dennell et al., 2011; MacDonald et al., 2012; Martinón-Torres et al., 2012). In Europe, the impossibility of satisfactorily fitting the primitive-derived morphological gradients of the human populations along a chronological sequence was the triggering notion for suggesting a discontinuous settlement of the continent, envisaging fragmentation, isolation and recombination of populations, strongly conditioned by biogeographical factors (Dennell et al., 2010, 2011). To the light of this evidence, some of us proposed a population model for Middle Pleistocene Europe that is based on demographic "sources" and "sinks" and where repeated colonization, extinctions and recombination may help explain the morphological variability of the inhabitants of Europe at that time (Bermúdez de Castro and Martinón-Torres, 2013; Dennell et al., 2011; MacDonald et al., 2012).

This paper aims to present a preliminary approach to the suitability of the "source and sink" model to explain the human settlement of the Asian continent. At this stage, we do not intend to perform a thorough analysis of the Asian fossil record and the biogeographical factors that may have shaped the demography of East Asia, but to investigate whether there are reasonable grounds to explore this possibility in future studies. In this context, it would be necessary to:

- characterise the variability of the Asian hominin populations;
- assess whether the primitive-derived gradients can be explained along a chronological scale;
- identify possible sources and sinks in East Asia.

Our objective is to provide a preliminary approach to these three requirements through an overview of the hominin dental evidence from East Asia.

1. "Source and sink" model in Europe

The origin of the Neanderthal lineage has been largely explained by the gradual accumulation of Neanderthal distinctions throughout time, a process that has been coined as *accretion* (Hublin, 1998). Despite their ability to cope with a variety of environments, Neanderthal ancestors would have had problems to survive in extreme glacial conditions. Glacial-interglacial cycles would have led to a pattern of periodical abandonment of northern regions into southern refuges and subsequent recolonisation of higher latitudes when conditions ameliorated (e.g., Bocquet-Appel and Demars, 2000; Turq et al., 1996). This habitat-tracking dispersals, together with an important number of local extinctions (Hublin and Roebroeks, 2009) would have played a major role in shaping these populations, leading to repeated genetic bottlenecks, and subsequent reduction of the variability of the Neanderthal lineage (Hublin, 2009).

However, the recent analysis of the dental and craniofacial evidence from the Middle Pleistocene assemblages of Atapuerca-Sima de los Huesos (Arsuaga et al., 2014; Martinón-Torres et al., 2012) has emphasized the impossibility of aligning in a chronological sequence, the primitive and derived traits of Middle Pleistocene populations. To be specific, our studies revealed that the Atapuerca Sima de los Huesos samples, dated to approximately 420 ka (Arnold et al., 2014), were more Neanderthal not only than other contemporaneous populations like those from Arago and Mauer, but also "more Neanderthal than some Neanderthal themselves" (Gómez-Robles, 2010; Gómez-Robles et al., 2007, 2011; Martinón-Torres et al., 2012; Prado-Simón et al., 2012). Thus, the Atapuerca evidence was not supportive of the statement that earlier specimens would show "incipient" Neanderthal morphology, while the later ones would exhibit full-blown "classic" Neanderthal anatomy (Dean et al., 1998; Harvati et al., 2010; Hublin, 1998).

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