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Nd-Sr Isotopic Evolution of Asian Dust: Tectonic and Climatic Implications

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The eolian deposits archived in the loess and Pacific pelagic sediments provide important information on the late Cenozoic atmospheric circulation and paleo-environmental condition of the source regions. In recent years, Nd-Sr isotope was widely used to trace the source of eolian dust. Systematic investigation on the Nd and Sr isotopes of potential source materials in recent years provides a solid bases to interpret the Nd-Sr isotopic evolution of Asian dust(Chen et al., 2007). Here we present new sedimentary records of Asian dust from Chinese Loess Plateau and Northwest Pacific, which may shed new light on regional tectonic and climatic evolution since the late Oligocene.

The Nd isotope of Chinese loess decreases while the Sr isotope increases progressively during 22-1.2Ma. This record is based a very narrow grain size range (28-45 μm) of silicate fraction so that potential influence of weathering and mineral sorting on Sr isotope is eliminated. Similar Nd-Sr isotopic evolution of Asian dust has also been detected in Northeast Pacific site GPC3 (Pettke et al., 2002). We interpret decreasing Nd isotope and increasing Sr isotopic ratio during 22-1.2Ma may reflect progressive uplift of Northeast Tibetan Plateau. The source region of Asian dust manly receives debris eroded

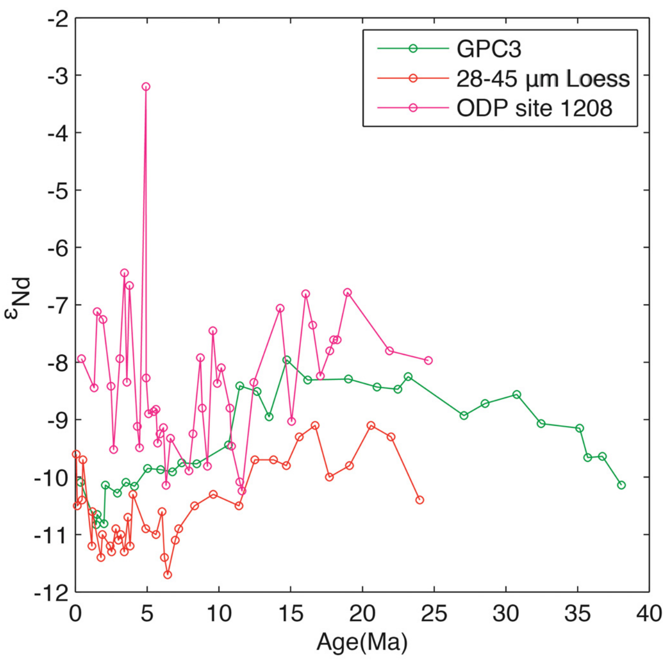

Fig.1 Evolution of silicate Nd isotope of ODP site 1208, GPC3 and Loess, GPC3 data are inferred from the (Pettle et al., 2002)

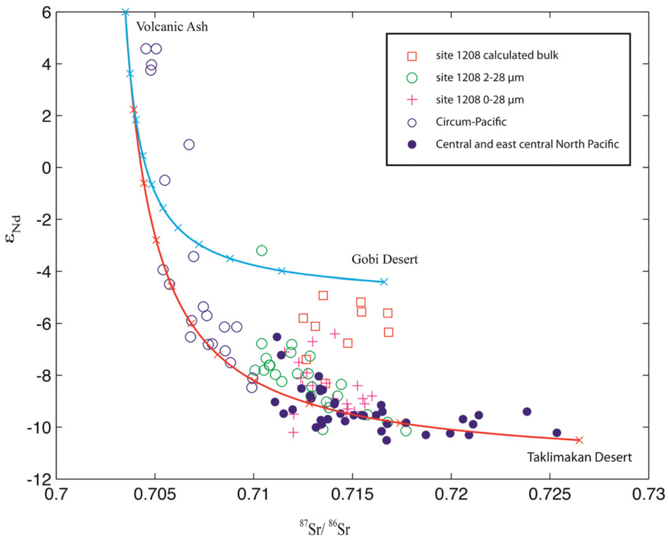

Fig. 2 Cross plot between silicate Nd and Sr isotopic compositions of Pacific sediment show mixing between circum-Pacific volcanic ash and Asian dust endmembers.

The composition of volcanic ash is follow the values used in Svensson et al. (2000) with εNd and $^{87}Sr/^{86}Sr$ of 6 and 0.7035 respectively, Nd and Sr concentrations of 15 ppm and 470 ppm respectively. Due to strong sorting effect on Sr isotopic composition, the $^{87}Sr/^{86}Sr$ ratios of Asian dust are based on < 5 μm grain size fraction of the surface sand in source regions, while the grain size effect for εNd value is not concerned. Gobi dust has average ε_{Nd} value of about -4.4 and average $^{87}Sr/^{86}Sr$ ratio of about 0.7166 based on the average of the surface sand in Central Asia Orogen (Chen et al., 2007; Li et al., 2011). Taklimakan dust has average ε_{Nd} value of about -10.5 and average $^{87}Sr/^{86}Sr$ ratio of about 0.7166 (Bory et al., 2003; Chen et al., 2007). Nd and Sr content of Asian dust are 40 ppm and 80 ppm respectively based on the < 5 μm grain size fraction of Chinese loess. The mixing lines are marked in 10% steps. Site 1208 calculated bulk means Nd-Sr isotopic compositions of bulk NICE component were calculated Assuming equal Nd and Sr contents in < 2 μm and 2-28 μm grain size fractions.

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from North Tibetan Plateau and Gobi Altay Mountains. Compared to Gobi dust, Tibetan materials have much lower Nd isotopic ratio and higher Sr isotopic ratio. Uplift may increase the relative contribution of Tibetan material, and thus shift the Nd and Sr isotope to Tibetan values. Since 1.2 Ma, the loess record indicates that the detritus contribution from Tibet drops rapidly in compare with that from Gobi. As large-scale topographic changes would not be expected in such a short time period, the source shift since 1.2 Ma is interpreted by the differing erosional responses in North Tibetan Plateau and Gobi Altay Mountains to the development of full glacial climate after the middle Pleistocene transition.

However, the patterns of Nd-Sr isotopic evolution observed in Chinese loess and pelagic sediment of Northeast Pacific have not been exactly detected in ODP 1208 core in Northwest Pacific(Fig.1). The Nd-Sr isotopic compositions don't match the hypothetical mixing line between volcanic ash and Taklimakan endmember which is generally regarded as the eolian source of Pacific pelagic sediments(Fig.2). We find that a separate contribution of pure Gobi dust by winter monsoon may explain the very different pattern recorded in ODP 1208 core. Considering the lack of Gobi material in Northeast Pacific sediment, the northwesterly winter monsoon might be responsible for the transportation of Gobi dust, which mainly influences the Northwest Pacific region. The Nd-Sr isotopic record in ODP 1208 core may reflect competition between Taklimakan dust and Gobi dust, which may have great potential in paleoclimatic and tectonic applications.

Key words: Nd-Sr isotopic evolution, Gobi dust, tectonic and paleoclimatic evolution, site 1208

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