The change in the environment and tectonics from Late Paleocene to Early Miocene in the Northeastern Tibetan Plateau

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Cenozoic is the time of global cooling from the early Eocene greenhouse to the Quaternary icehouse. The Eocene-Oligocene Transition (EOT) is the first rapid cooling step in the Cenozoic that occurred around 34 Ma. One of the critical changes during the EOT is the emergence of the permanent Antarctic ice. DeConto and Pollard (2003) suggested that the decrease of the percentage of carbon dioxide in the atmosphere during Eocene-Oligocene was the probable cause of the abrupt cooling at the Eocene-Oligocene Boundary (EOB), but exactly when and the reason why the reduction in the atmospheric occurred is not clear. Raymo and Ruddiman (1992) hypothesized that the intensification of weathering associated with the uplift of the Himalaya and Tibetan Plateau (HTP) caused atmospheric decrease. Although it is essential to clarify when and how HTP evolved and how its evolution was related to the atmospheric decrease, in order to test this hypothesis, the timing and mode of the HTP uplift is still under debate (Tada et al., 2016). In the northeastern Tibetan Plateau, the aridification and cooling linked with the elevation increase were suggested to have started before the EOB based on the pollen record (Dupont-Nivet et al., 2008). However, clear evidence of the tectonic uplift event and its temporal relationship with EOB is needed for further discussion. In this research, we examined the provenance of quartz in the terrestrial sediments of the Lanzhou Basin, the northeastern Tibetan Plateau to detect the signal of uplift and examine the temporal ralation between the uplift, cooling and the desertification.

We conducted field survey at the Duitinggou section in the northeastern edge of the Tibetan plateau, make a route map and a columnar section, and collected samples for analyses. We correlated our columnar section with a columnar section of Zhang (2015) constructed at the nearby section, and projected their age model, which is constructed based on magnetostratigraphy to our columnar section. We analyzed the grain size distribution of major lithologies to distinguish the sedimentary facies and characterize the lithological units. We also measured Electron Spin Resonance (ESR) intensity of quartz in the two grain size fractions to examine the provenance changes.

According to the result, Duitinggou section can be divided into six sedimentary units from 1 to 6 in ascending order and based on the constructed age model, the age of Duitinggou section ranges from about 57.6 Ma to 18.9 Ma, i.e. from Late Paleocene to Early Miocene.

Based on the result of the grain size analysis, we classify four patterns of the grain size distributions interpreted as fluvial sediments, lacustrine sediments, aeolian deposits and mixed sediments, respectively. The >63 μm sandstone samples were considered to have represented as mostly fluvial sediments. A gradual increase in the ESR intensity of quartz from 50 Ma to 24 Ma is interpreted as the evidence of unroofing in the source area. It seems that the uplift of the source area occurred before 50 Ma. A sudden decrease in the ESR intensity around 24 Ma suggested a major tectonic uplift and exposure of low grade metamorphic rocks occurred at that age, which might be related to the uplift of the northeastern Tibetan Plateau that started around 24Ma.

Keywords: Northeastern Tibet, Uplift, Lanzhou basin, EOT, ESR