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Prehistorical spread of carnelian beads along the Silk Roads

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The use of carnelian beads as ornaments in China became prominent during the mid- to late Western Zhou period. Earlier carnelian beads are widely thought to have originated from West Asia and South Asia, initially entering China's border regions before gradually spreading to the Central Plains. In this study, we extensively collected carnelian mineral specimens from China and neighboring regions. Using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS), we analyzed their trace element compositions to construct the most comprehensive chemical composition database for carnelian to date. Multivariate statistical analysis was then employed to establish distinguishing criteria for carnelian from different regions. We focused on archaeological carnelian specimens from seven sites in Northwest to North China, dating from 5000 to 3000 years before present. Through trace element analysis, we identified the primary sources of carnelian materials and reconstructed the diffusion patterns of prehistoric carnelian along the Silk Roads. The chemical composition of carnelian varies significantly depending on the geological origin of the raw materials, enabling precise tracking of their sources. The earliest known carnelian beads in China, dating to approximately 5 ka BP, were discovered in Northwest China and were made from South Asian materials. The easternmost distribution of South Asian carnelian materials was identified at the Bronze Age Huoshaogou site in the Hexi Corridor. By around 3.4 ka BP, carnelian production became localized, with the Yanshan and Mongolian Plateau regions emerging as the primary sources of raw materials for eastern China. Our findings reveal a material exchange network dating back 3,000 years, highlighting the Yanshan region as a key source of carnelian and shedding light on the prehistoric exchange dynamics along the Silk Roads.