The northwest Jiaodong Peninsula is dominated by a NNE-SSW trending Linglong massif situated in Pingdu–Laizhou–Zhaoyuan area. The Linglong massif mainly consists of migmatitic and granitic rocks, and is surrounded by the Late Archaean and Palaeoproterozoic rocks. Recent study shows that the Linglong massif is an asymmetric Metamorphic Core Complex (MCC) (Charles et al., 2013), comprising a lower unit, separated from an upper unit to the east by a master Linglong detachment fault (LDF). The Linglong MCC hosts the majority of gold resources (>95%) in the Jiaodong Peninsula (Deng et al., 2008; Yang et al., 2007; Wang et al., 2014a). These gold deposits are characterized by the auriferous quartz-veins (“Linglong-type”) and the disseminations/stockworks (“Jiaojia-type”) (Deng et al., 2006; Wang et al., 2014b; Yang et al., 2009). The “Linglong-type” gold deposits are closely linked to the high-angle small-scale brittle faults particularly developed in granitic lithology, and the “Jiaojia-type” gold deposits occur along the NE- to NNE-trending structures bordering the Linglong MCC. Both the Dayingezhuang and Xiadian gold deposits, characterized by the main disseminations/stockworks with subordinate auriferous quartz-veins, are located along the LDF. The disseminated- and stockwork-style orebodies, hosted in cataclasty and deformed Linglong granites with the alteration of quartz–sericite–pyrite, are controlled by the NNE- to NE-trending LDF. The auriferous veins hosted in the granites with K-feldspar alteration, are controlled by the NE-trending high-angle normal faults, as well as the NE-trending tensile joints and fissures.

In this study, zircon and apatite fission-track thermochronologic analysis were conducted on the samples from the three units of Linglong MCC (the lower unit, the upper unit and the LDF). The ZFT age from 151.8±10.1 Ma to 135.0±7.0 Ma obtained for the samples of the footwall of the LDF is consistent with the 40Ar/39Ar muscovite age of 142.81±1.43 Ma from the core of the Linglong MCC (Charles et al., 2013), showing rapid cooling from ~450 °C to ~220 °C at the rate of up to ca. 230 °C / Ma between ca. ~143 Ma and ~135 Ma. Such high rates are suggested to be linked to rapid unroofing by detachment faulting in core complexes. The ZFT ages ranging from 135.0±7.0 Ma to 152.6±9.8 Ma for the hanging wall overlap within error with those of the footwall of the LDF, implying that no later ductile movement occurred along the LDF since 135.0±7.0 Ma. Furthermore, the AFT ages in both the footwall and the hanging wall of the LDF show no clear trend in the top-to-the-SE slip direction, and they are also similar across the LDF, indicating that the Linglong MCC cooled as a whole very slowly from 220°C at 135.0±7.0 Ma, to near surface temperatures of 50-70°C at ca. 24-33 Ma. Combined with the 40Ar/39Ar muscovite age of 133.98±1.47 Ma from the LDF mylonites (Charles et al., 2013), we suggested that the relative offset along the LDF must have ceased since ca. 134 Ma.

The ZFT ages of gouge samples from the fracture zone indicate that brittle movement occurred along the LDF between ca. 130 Ma and 115 Ma, which is consistent with the recognition of Charles et al. (2013) who suggested that the brittle deformation was proceeding between ca. 130 Ma and 126 Ma, and is also supported by the fact that the cataclastic and brecciated rocks overprinted in the mylonitic-ultramylonitic zone of the LDF. The strong silicification, sericitization and sulfidation alteration associated with the cataclastic and brecciated rocks, and the
auriferous veins controlled by the NE-trending brittle faults indicate that the fluid migration and gold deposition occurred later than the brittle deformation.

The three sericite and one muscovite samples from the Dayingezhuang deposit yield well-defined $^{40}$Ar/$^{39}$Ar plateau ages of 126.8 ± 0.59 Ma to 133.4 ± 0.6 Ma, indicating that the main stage of gold mineralization is constrained to the period of 130 ± 4 Ma and is older than 120 ± 5 Ma, the widely accepted main ore-forming period of the other major gold deposits in the northwestern part of the Jiaodong gold province. Although whether gold deposits throughout northwest Jiaodong gold province were formed during a single protracted event or during multiple and distinct episodes is still uncertain, it is suggested that the duration of ore formation in this giant gold province was at least 15-20 million years (Yang et al., 2014). Our zircon fission-track thermochronologic study shows that the ZFT age of 130.1±6.5 Ma for the auriferous veins overlap in time within error with that of 122.9±6.7 Ma for the disseminated- and stockwork-style orebodies at Xiadian gold deposit. Furthermore, no clear crosscutting relations are observed between the two types of gold mineralization. Therefore, the main ore-forming period of northwest Jiaodong gold province is likely to be ca 134-115 Ma, which is consistent with the period of the brittle deformation of LDF.

In short, the migmatitic and granitic rocks of the massif were rapidly uplifted, at rates of at least 1 km/m.y. from depths of 25–30 km between ca. 143 and 134 Ma, to form the Linglong MCC, and the brittle overprinting was proceeding from ca. 134 Ma to 115 Ma. During the brittle reactivation deformation of the LDF, the fluid migration and gold deposition occurred.

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