

**Supplementary Table S1.** Major element mass fractions (wt.%) of the PZH12-09 ilmenite determined using routine EPMA method.

**Supplementary Table S2.** Major (wt.%) and trace element ( $\mu\text{g/g}$ ) mass fractions of the PZH12-09 ilmenite determined using LA-ICP-MS.

**Supplementary Table S3.** Major element (wt.%) and trace element ( $\mu\text{g/g}$ ) mass fractions of the PZH12-09 ilmenite determined using SM ICP-MS.

**Supplementary Table S4.** Major and trace element composition ( $\mu\text{g/g}$ ) of the PZH12-09 ilmenite using high-precision EPMA method.

**Supplementary Fig. S1** Frequency distributions of trace elements determined by LA-ICP-MS, indicating normal distributions and demonstrating the homogeneity of the studied PZH12-09 ilmenite.