Full figure captions, "Recycling deep cratonic lithosphere and generation of intraplate magmatism in the North China Craton" by Gao et al.

Figure 1: Geologic sketch map of the North China craton (shaded on inset). The two suites of Early Cretaceous lavas under investigation (large filled crosses) are from Sihetun, in western Liaoning, and Feixian, in western Shandong. WB, TNCO and EB denote three-fold division of the North China craton into the Western Block, Trans-North China Orogen and Eastern Block, respectively (*Zhao et al.*, 2005). NSGL indicates the North-South Gravity Lineament (*Griffin et al.*, 1998). Also shown are locations of the Early Mesozoic high-Mg Xinglonggou intermediate-felsic lavas (open cross) (*Gao et al.*, 2004), Archean peridotite xenoliths (squares) from Ordovician kimberlites [Teiling (*Wu et al.*, 2006), Fuxian (*Gao et al.*, 2002; *Zhang et al.*, 2008), Menyin (*Gao et al.*, 2002; *Zhang et al.*, 2008)] and ~130 Ma high-Mg diorite (Laiwu) (*Chen & Zhou*, 2006; *Xu et al.*, 2008) and younger peridotite xenoliths (stars) (*Gao et al.*, 2002; *Wu et al.*, 2003; *Zheng et al.*, 2006) from Late Mesozoic (102-106 Ma, Jianguo, *Zhu et al.*, 2004) or Cenozoic (Longgang, Qixia, Shangwang, Chengle, and Hannuoba) alkali basalts. Triangles designate granulite, pyroxenite and eclogite xenolith localities from Jurassic diatremes at Xinyang (*Zheng et al.*, 2004) and 130–132 Ma high-Mg dioritic-monzodioritic porphyries at Xu-Huai (*Xu et al.*, 2006). Inset shows major tectonic divisions of China, where the North China craton is shaded and YZ and SC denote the Yangtze craton and South China Orogen, respectively. The extension of the border between the North China craton and the Yangtze craton into Korea is based on *Lee & Walker* (2006).

Figure 2: Left: Fo (forsterite = 100Mg/(Mg+Fe), where Mg and Fe represent molar proportions) versus wt.% CaO plot of olivine cores from Early Cretaceous Feixian alkaline picrites and Sihetun high-Mg basalts. Average compositions (±1σ) of olivines from NCC peridotite xenoliths are shown for comparison [large square: Archean peridotite xenoliths from Ordovician kimberlites; diamond: peridotite xenoliths from Early Cretaceous (~130Ma) high-Mg diorite (Laiwu); triangle: lherzolite xenoliths from Cenozoic alkali basalts]. High Fo peridotites (Ordivician kimberlites and some Laiwu xenoliths) derive from Archean NCC lithosphere. Lower Fo peridotites (some Laiwu xenoliths and Cenozoic basalt xenoliths) represent younger lithospheric mantle formed after removal of the Archean mantle. Olivines from the Sihetun basalts have CaO ≥ 0.10%, characteristic of a magmatic origin (*Thompson & Gibson*, 2005) and $Fo_{89\text{–}92}$ in the core. In contrast, those from the Feixian pictrites show a range of CaO (< 0.01 to 0.18%), indicating both phenocrystic and xenocrystic origins. Right: Fo histograms show the systematic compositional differences in olivines from different sources. Olivines from the Feixian picrites, with CaO≥0.10%, have Fo<92, consistent with a magmatic origin, whereas those with CaO < 0.10% have Fo >92, consistent with a xenocrystic origin. See *Gao et al.* (2008) for data sources.

Figure 3: Core-exterior compositions of reversely zoned clinopyroxene phenocrysts from the Feixian alkaline picrites. (a) backscattered electron image (BSE) and (b) compositional profile of a euhedral clinopyroxene phenocryst along [010] plane from sample SFX19. The dark areas are Mg-rich and the light areas are Fe-rich. In contrast to the Fe- and Na-enriched

core, the exterior shows markedly higher Mg (thus higher Mg#) and Cr contents. The sharp and irregular boundary between the core and mantle indicates that the mantle is a later overgrowth by chemical reaction, with little diffusive exchange between the two regions. In contrast, the compositional variation at the edge of the crystal is regular, and likely reflects shallow-level differentiation. The main Mg# versus Na_2O plot and (c) Mg# histogram compare experimental clinopyroxenes in equilibrium with melts derived from eclogite (including garnet pyroxenite), peridotite and hybrid eclogite (ecl.)-peridotite (per.). Clinopyroxenes from eclogite-derived melt are characterized by Mg# < 87 and Na_2O > 1.0%, as demarcated by the dash lines, whereas most of those from peridotite-derived melt, whether from anhydrous or hydrous melting, have higher Mg# and lower Na_2O. Clinopyroxenes from hybrid eclogite-peridotite melt overlap the entire range of those from eclogite- and peridotite-derived melts. Although eclogite and clinopyroxenite with high Mg# [either in whole rocks, e.g. > 81 (*Kogiso & Hirschmann*, 2001) or clinopyroxene ~91 (*Skjerlie & Patino Douce*, 2002)] may produce melts yielding clinopyroxene with Mg# similar to those from peridotite-derived melt, such high Mg#s are considerably higher than those found in common eclogites and their clinopyroxenes and also those of the Xu-Huai eclogites/garnet clinopyroxenites (Mg# < 75) and clinopyroxenes (Mg# <85), which are considered a good approximation for the mafic lower crust of the North China craton (*Gao et al.*, 2004; *Xu et al.*, 2006). These experimental data are therefore not included in the comparison. The core and exterior compositions are consistent with crystallization of the clinopyroxenes from eclogite- and peridotite-derived melts, respectively, and agree with the compositional range of clinopyroxenes from hybrid, eclogite-peridotite-derived melt. See *Gao et al.* (2008) for data sources.

Figure 4: Compositions of primary melts calculated for the Feixian alkaline picrites and Sihetun high-Mg basalts. (a) Mole% projection from or towards olivine into part of the pyroxene-garnet plane compared with cotectics at 3 and 4 GPa (*Herzberg*, 2006). Thick line labelled "TD" is the thermal divide between olivine-rich and SiO_2 rich sides of the composition space. Note that except for three Sihetun samples, which appear to have melted along the cotectic L+Ol+Cpx+Gt, the other Sihetun samples appear to have melted along the cotectic L+Opx+Cpx+Gt on the olivine-rich side. In contrast, all Feixian samples appear to have melted along the cotectic L+Ol+Cpx+Gt. (b) MgO versus CaO. Filled and open triangles indicate primary melts and solidus melts from peridotites (*Herzberg*, 2006; *Sobolev et al.*, 2007), while filled diamond represents primary melt from pyroxenite (*Sobolev et al.*, 2007). Shaded area denotes accumulated fractional melt compositions for a pressure range from 3 to 7 GPa (*Herzberg*, 2006). Filled and open circles with a cross indicate high- and low SiO_2 Hawaiian parental magmas (*Herzberg*, 2006). Arrows display the effects of olivine addition (right pointing) and subtraction (left pointing; *Herzberg*, 2006). The Feixian and Sihetun primary melts are too low in CaO to be derived from normal mantle peridotites. Instead, they likely derive from pyroxenite sources. (c) Ni/MgO versus 100Mn/Fe ratios of primary melts compared to experimentally produced peridotite- (FeO=9.68 wt%, MnO=0.185 wt%, MgO=19.07 wt%, Ni=642 ppm, 100Mn/Fe=1.90, Ni/MgO=34) and pyroxenite-derived

(FeO=8.24 wt%, MnO=0.117 wt%, MgO=13.32wt%, Ni=830 ppm,100Mn/Fe=1.42, MgO=62) end-member melts [Supplementary Table S2 of *Sobolev et al.* (2007)].

Figure 5: γ_{Os} versus ε_{Nd} mixing diagram for silicic melt-peridotite mixtures as discussed in the text. Starting peridotite compositions are shown as stars. Solid star reflects ancient NCC peridotite (γ_{Os} = -14.5, 3.7 ppb Os; ε_{Nd} = +8, 3.0 ppm Nd). Open star is peridotite with chondritic Os isotopes and same concentrations and Nd isotopes as ancient peridotite. Starting adakitic melt compositions for the models are beyond the scale of the figure. Assumed melt compositions are as follows: black curve: γ_{Os} = +3756, 0.078 ppb Os; ε_{Nd} = -7, 28 ppm Nd; dark gray curve: γ_{Os} = +3756, 0.078 ppb Os; ε_{Nd} = -4.5, 28 ppm Nd), light gray curve: γ_{Os} = +3756, 0.078 ppb Os; ε_{Nd} = -14.5, 28 ppm Nd). Triangles, squares and circles show increments of 10% mixing of melt into peridotite. Boxes show estimated compositions of Sihetun basalt and Feixian picrite sources.