

Table S1. Stable and radiogenic isotope data for carbonate minerals and DIC from Mount Keith (TSF2 and TSF1) [1].

Sample ^a	Mode	Major Carbonate-Bearing Phases ^b	Minor Carbonate-Bearing Phases ^b	$\delta^{13}\text{C}$ (‰, VPDB)	$2\sigma_{\delta^{13}\text{C}}$ (‰, VPDB) ^c	$\delta^{18}\text{O}$ (‰, VSMOW)	$2\sigma_{\delta^{18}\text{O}}$ (‰, VSMOW) ^c	F^{14}C	$\sigma_{\text{F}^{14}\text{C}}$	WGS 84 Easting	WGS 84 Northing	Sample Depth (m)
06MK56	DIC, water			-8.16	0.14							
Kidney water pump station	DIC, water			-7.71	0.13							
MKO side pond	DIC, water			-6.20	0.11							
MKO thickener tailings	DIC, water			-6.91	0.22							
Tailings thickener overflow	DIC, water			-4.60	0.10							

Table S2. The Sr and C isotope from the carbonatites derived from the mantle.

	$^{87}\text{Sr}/^{86}\text{Sr}$	$\delta^{13}\text{C}$	Ages	Locate	Reference
Carbonatites	0.7095-0.7106			Shandong, China	[2]
Carbonatites	0.7020-0.7054		Proterozoic to tertiary	Africa, Australia, brazil, Europe, united states	[3]
Carbonatites	0.703-0.705				[4]
Natrocronatite lavas		-6.3~-7.1	1988	Oldoinyo Lengai	[5]
Carbonatites	0.7078-0.7079	-11.2 ~-12.3	cenozoic	Hebei, China	[6]
Carbonatite complex	0.70541-0.70536	-4.5~-7.8	2060 Ma	Phalabonatite, South Africa	[7]
Carbonatite complex		-5.1			[8]
Oceanic carbonatites	0.7032			Cape Verde and Canary Islands	[9]

Table S3. The Sr and C isotope from the Panxi mafic intrusion.

Sr	$\delta^{13}\text{C}$		
0.7043-0.7054			[10]
0.7057-0.7076			[11]
0.7056-0.7074			[12]
0.705-0.711	Brucite marble and zebra rocks is -3 and +5	Dolomites $87\text{Sr}/86\text{Sr}$ is 0.708 Olivine marble is 0.708 to 0.711	[13]

Reference:

1. Wilson, S.A., et al., *Offsetting of CO₂ emissions by air capture in mine tailings at the Mount Keith Nickel Mine, Western Australia: Rates, controls and prospects for carbon neutral mining*. International Journal of Greenhouse Gas Control, 2014. **25**: p. 121-140.
2. Ying, J., X. Zhou, and H. Zhang, *Geochemical and isotopic investigation of the Laiwu? Zibo carbonatites from western Shandong Province, China, and implications for their petrogenesis and enriched mantle source*. Lithos, 2004. **75**(3-4): p. 413-426.
3. Nelson, D.R., et al., *Geochemical and isotopic systematics in carbonatites and implications for the evolution of ocean-island sources*. Geochimica Et Cosmochimica Acta, 1988. **52**(1): p. 1-17.
4. Bell, K. and G.R. Tilton, *Probing the mantle: The story from carbonatites*. Eos Transactions American Geophysical Union, 2002. **83**(25): p. 273-277.
5. Keller, J. and J. Hoefs, *Stable Isotope Characteristics of Recent Natrocarbonatites from Oldoinyo Lengai*. 1995: Springer Berlin Heidelberg. 113-123.
6. Fan, Q.C., et al., *Genesis of carbonatite from Hannuoba and Yangyuan*. Acta Petrologica Sinica, 2010. **26**(11): p. 3189-3194.
7. Wu, F.Y., et al., *In situ determination of U-Pb ages and Sr-Nd-Hf isotopic constraints on the petrogenesis of the Phalaborwa carbonatite Complex, South Africa*. Lithos, 2011. **127**(1-2): p. 309-322.
8. Deines, P., et al., *Isotopic composition of carbonatite and kimberlite carbonates and their bearing on the isotopic composition of deep-seated carbon*. Geochimica Et Cosmochimica Acta, 1973. **37**(7): p. 1709-1733.
9. Hoernle, K., et al., *Geochemistry of oceanic carbonatites compared with continental carbonatites: mantle recycling of oceanic crustal carbonate*. Contributions to Mineralogy and Petrology, 2002. **142**(5): p. 520-542.
10. Howarth, G.H. and S.A. Prevec, *Trace element, PGE, and Sr-Nd isotope geochemistry of the Panzhihua mafic layered intrusion, SW China: Constraints on ore-forming processes and evolution of parent magma at depth in a plumbing-system*. Geochimica et Cosmochimica Acta, 2013. **120**: p. 459-478.

11. Yu, S.Y., et al., *Integrated O–Sr–Nd isotope constraints on the evolution of four important Fe–Ti oxide ore-bearing mafic–ultramafic intrusions in the Emeishan large igneous province, SW China*. *Chemical Geology*, 2015. **401**: p. 28-42.
12. Zhong, H., et al., *Trace-element and Sr–Nd isotopic geochemistry of the PGE-bearing Xinjie layered intrusion in SW China*. *Chemical Geology*, 2004. **203**(s 3–4): p. 237-252.
13. Ganino, C., et al., *Assimilation of carbonate country rock by the parent magma of the Panzhihua Fe–Ti–V deposit (SW China): Evidence from stable isotopes*. *Geoscience Frontiers*, 2013. **4**(5): p. 547-554.