Examples of Cu-Ni Deposits in Dynamic Magma Conduit
岩浆通道型铜镍矿床典型实例

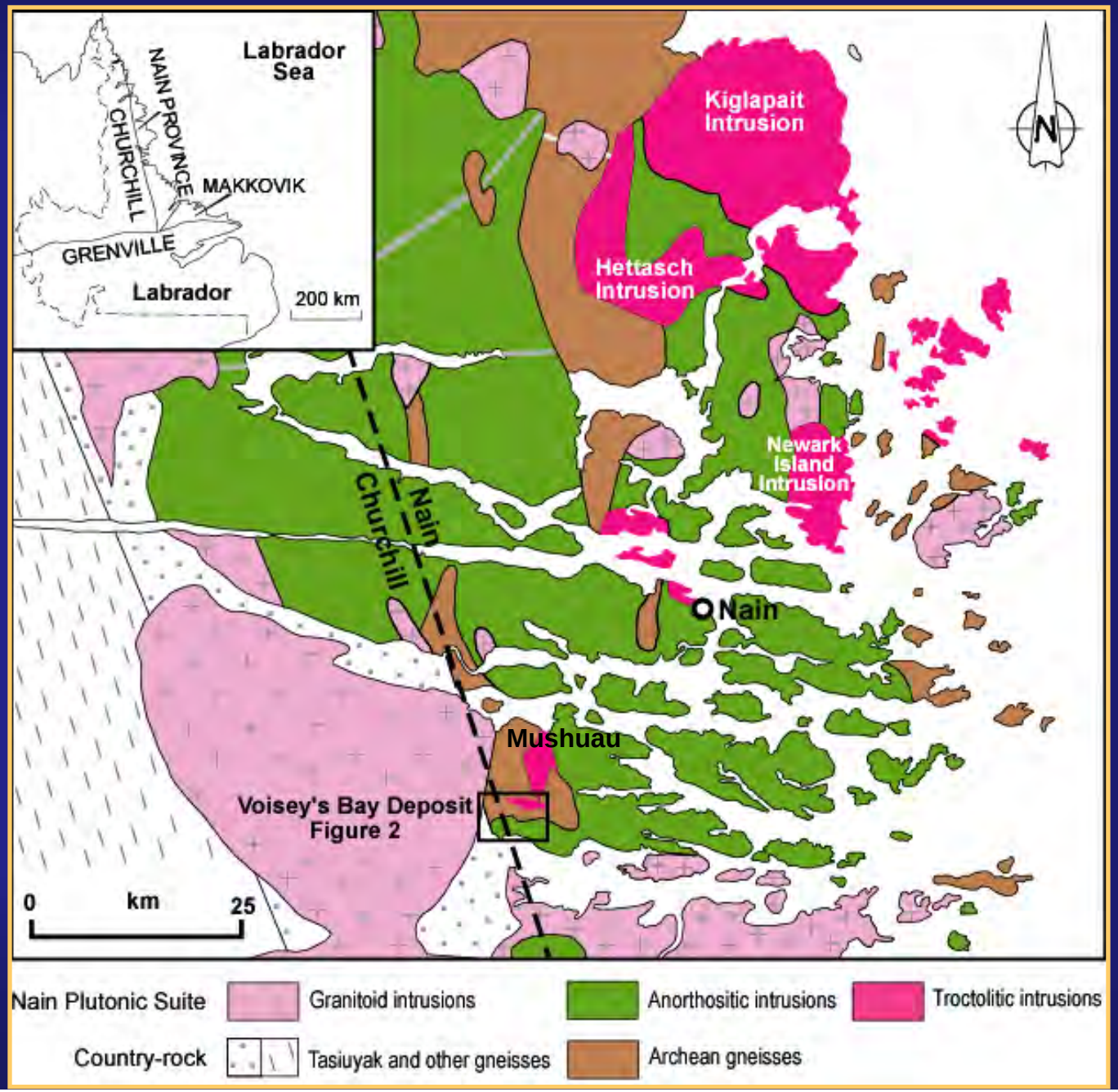
(1) Voisey's Bay Deposit, Labrador, Canada
加拿大拉布拉多地区的 Voisey's Bay 矿床

(2) Kharaelakh Deposit, Noril'sk Region, Siberia
西伯利亚 Noril'sk 地区的 Kharaelakh 矿床

Voisey's Bay Regional Geology

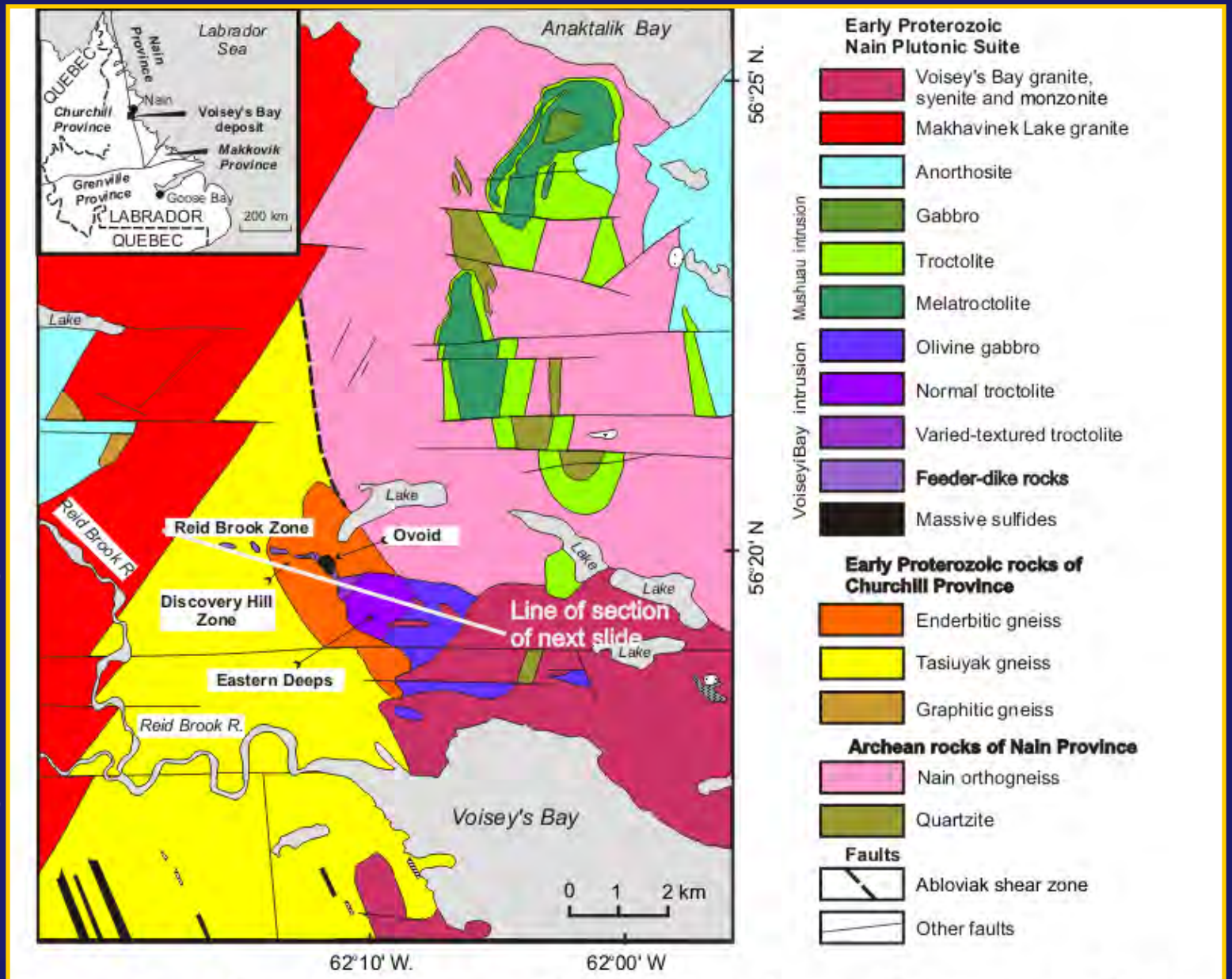
1st Example: Voisey's Bay Deposit

Voisey's Bay 区域地质图



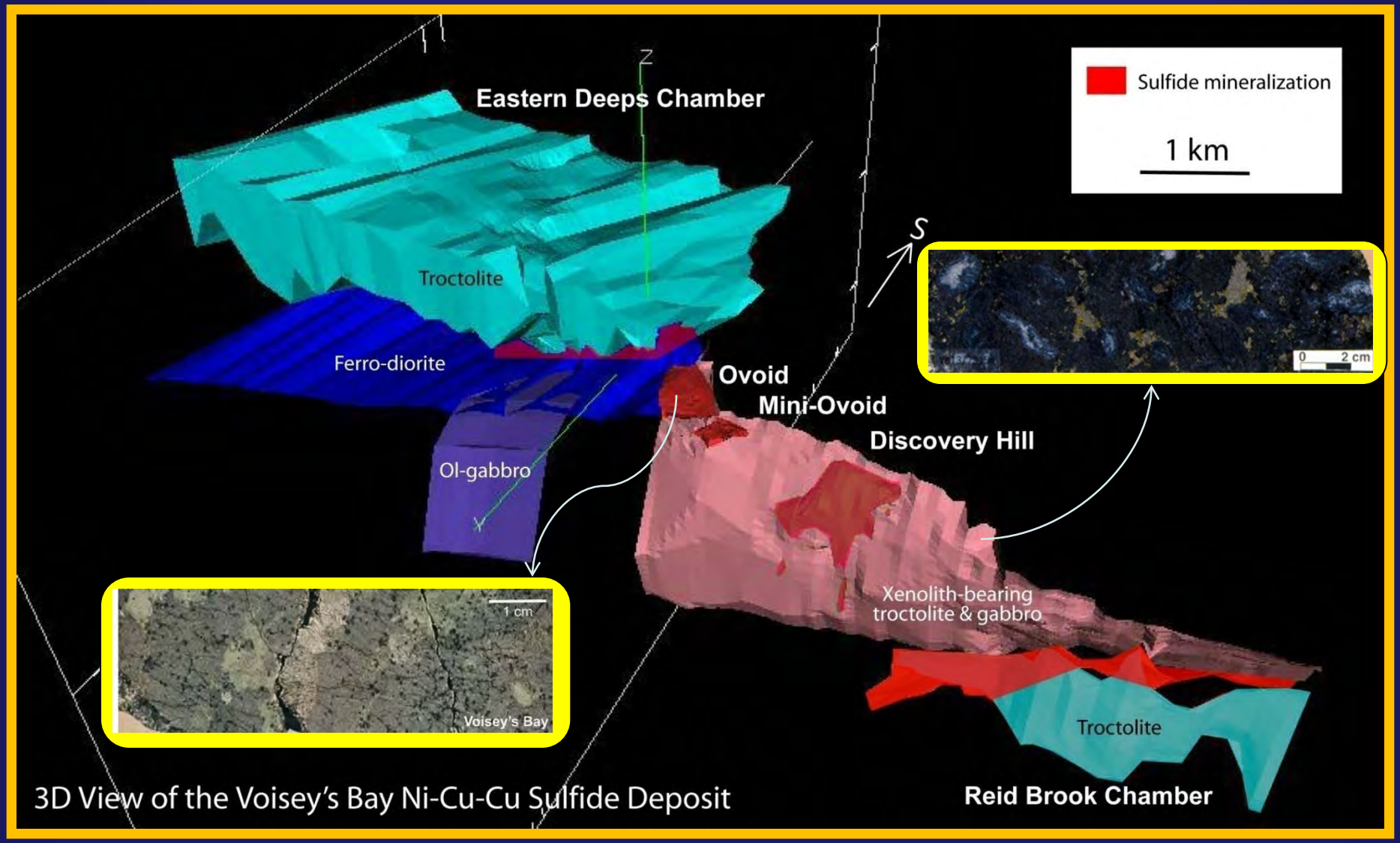
Geology of the Voisey's Bay Intrusion

Voisey's Bay 岩体地质图

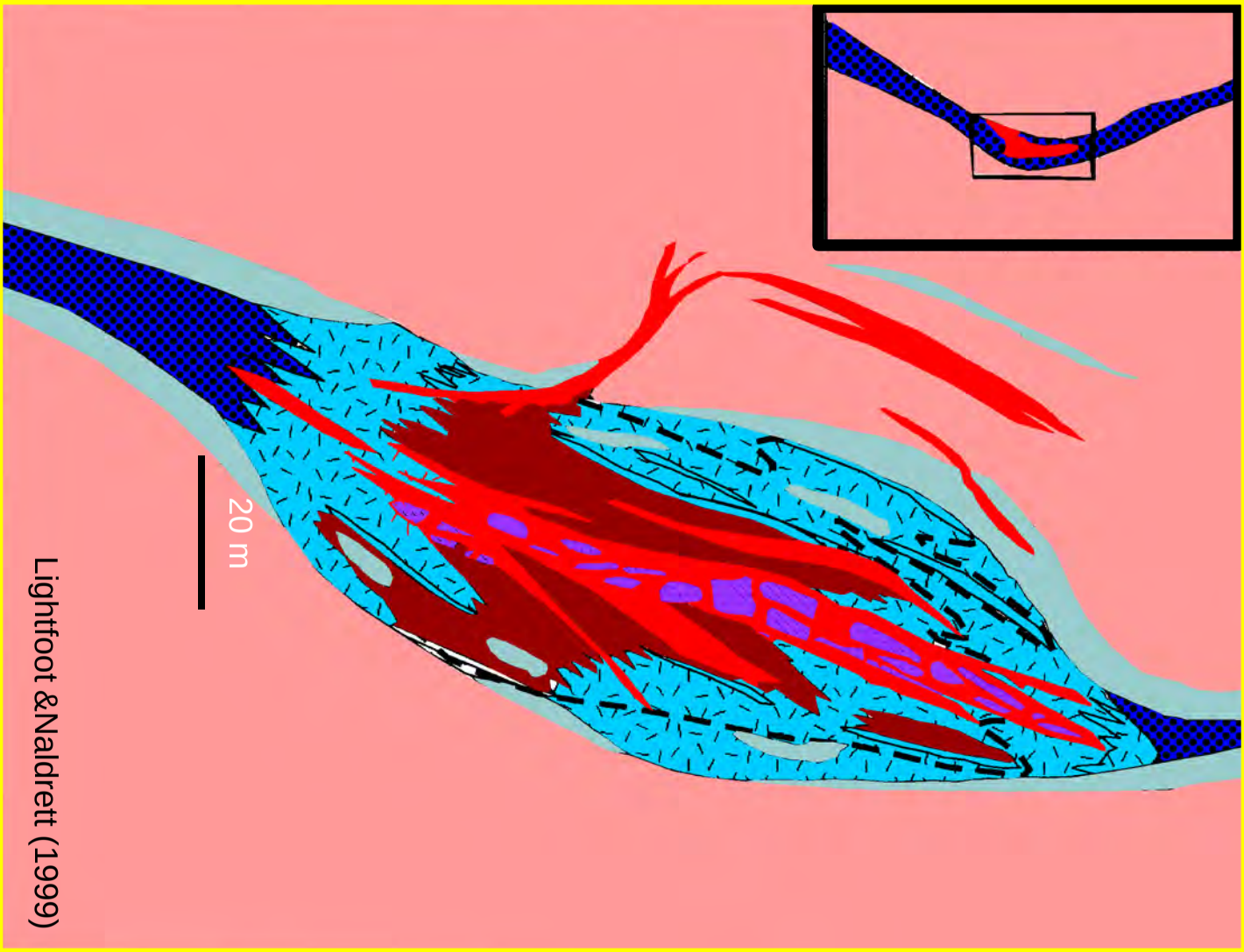


Geological Map of the Voisey's Bay Area

3D View of the Voisey's Bay Deposit
Voisey's Bay 矿床立体图

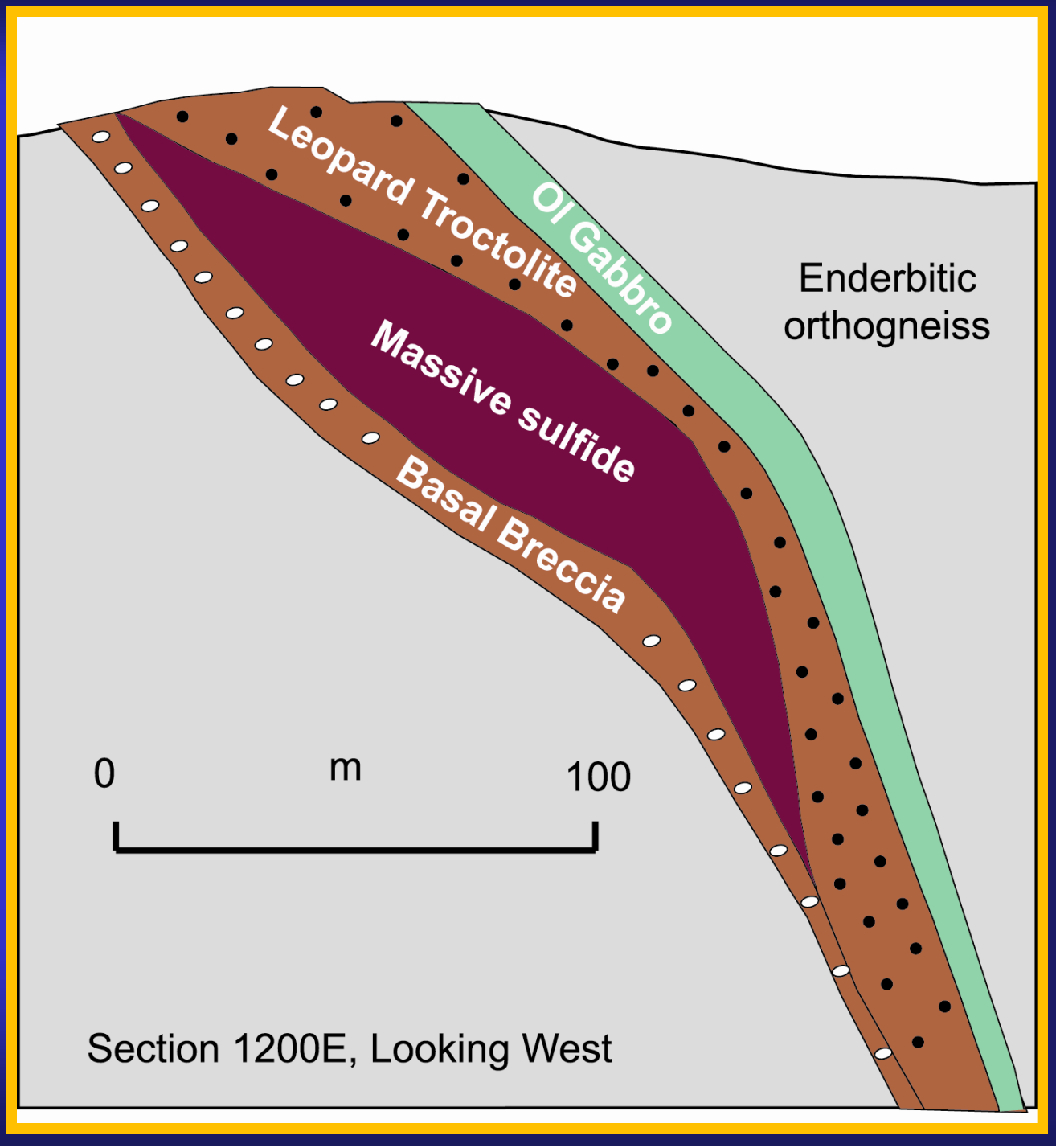


Cross Section Close to the Exit of the Lower Chamber
下岩浆房出口附近剖面图

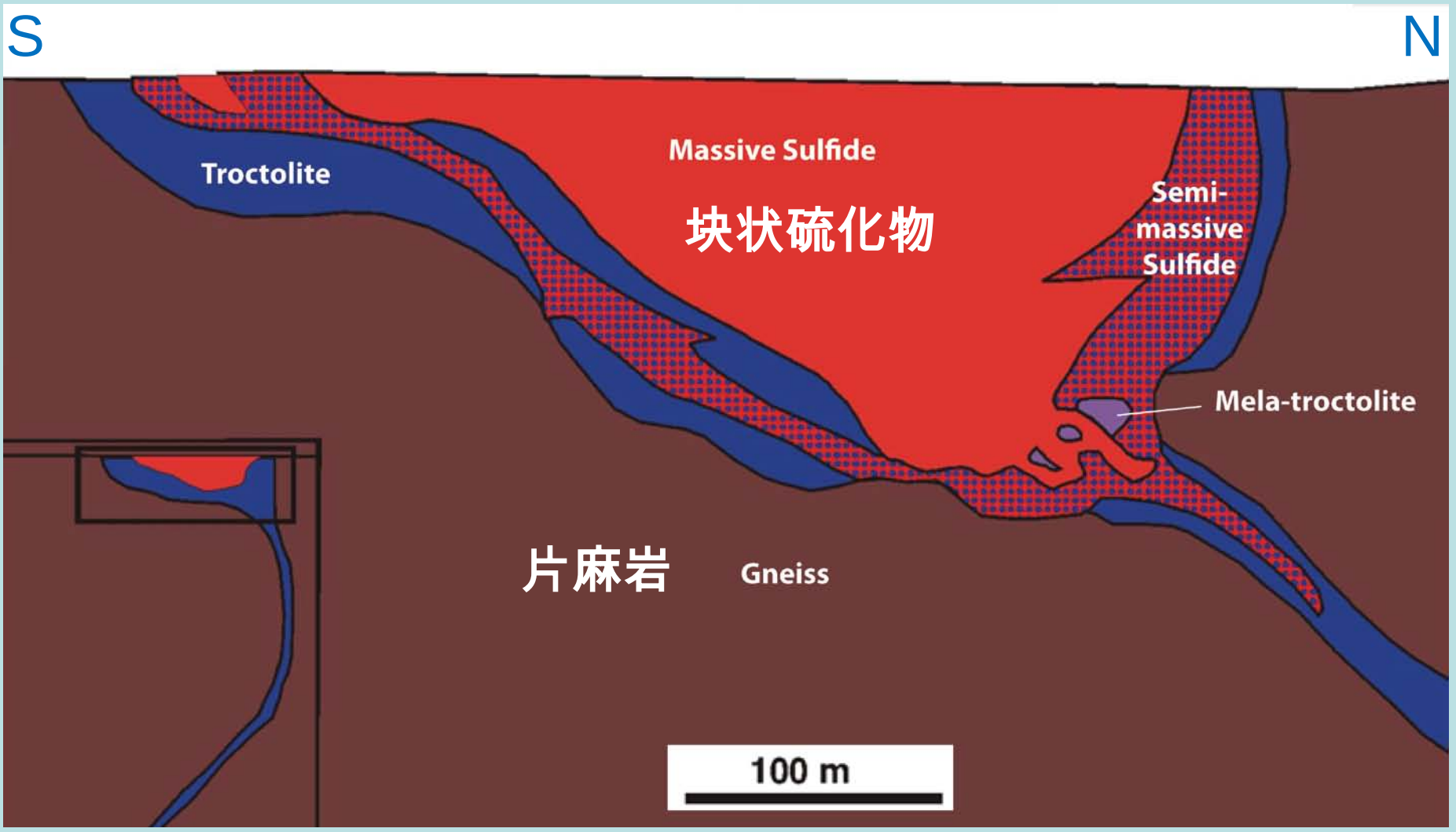


Lightfoot &Naldrett (1999)

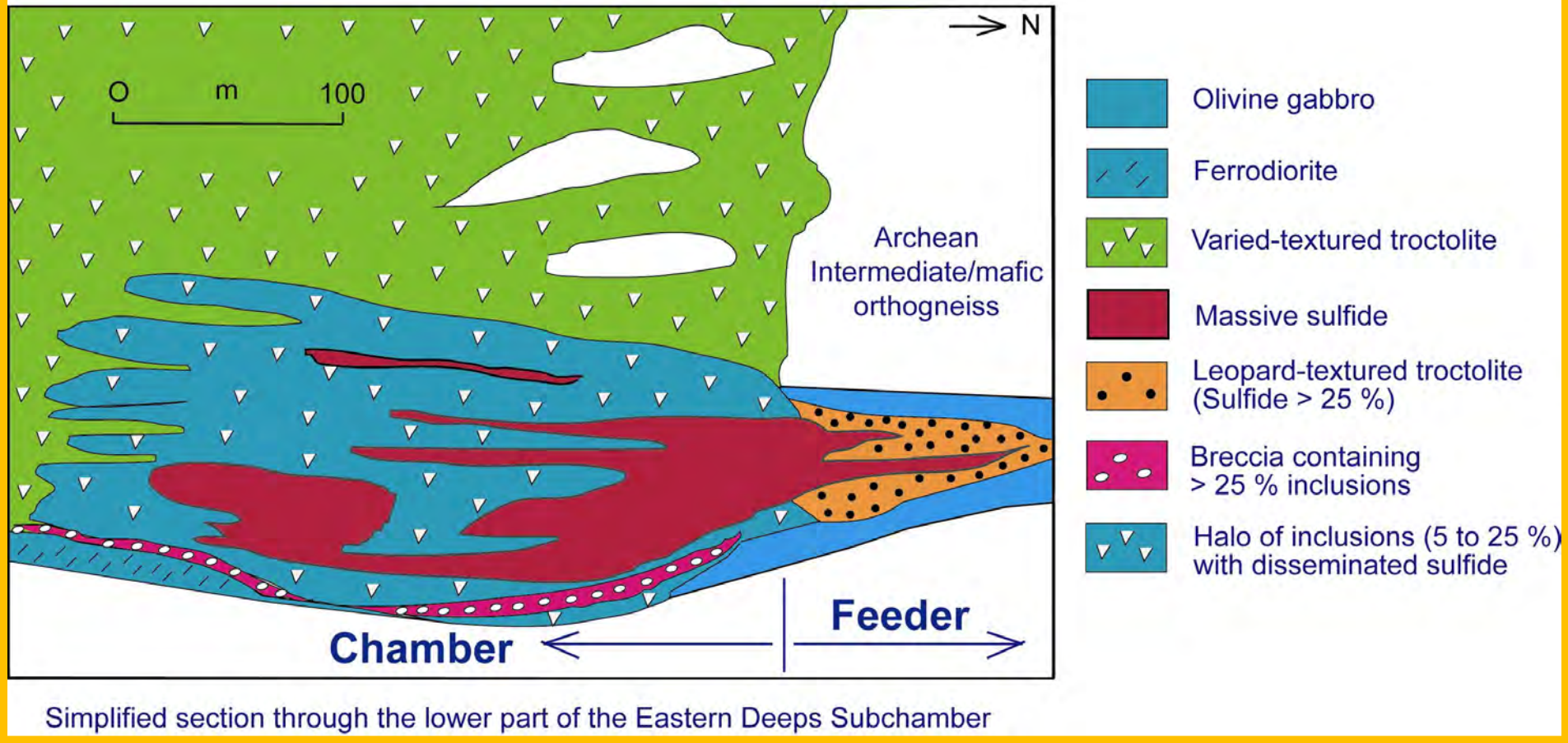
Discovery Hill Feeder Dyke Cross Section
岩浆通道 (岩墙) 剖面图



Cross Section of the Ovoid Orebody Close to the Upper Chamber
上岩浆房附近卵圆形矿体剖面图



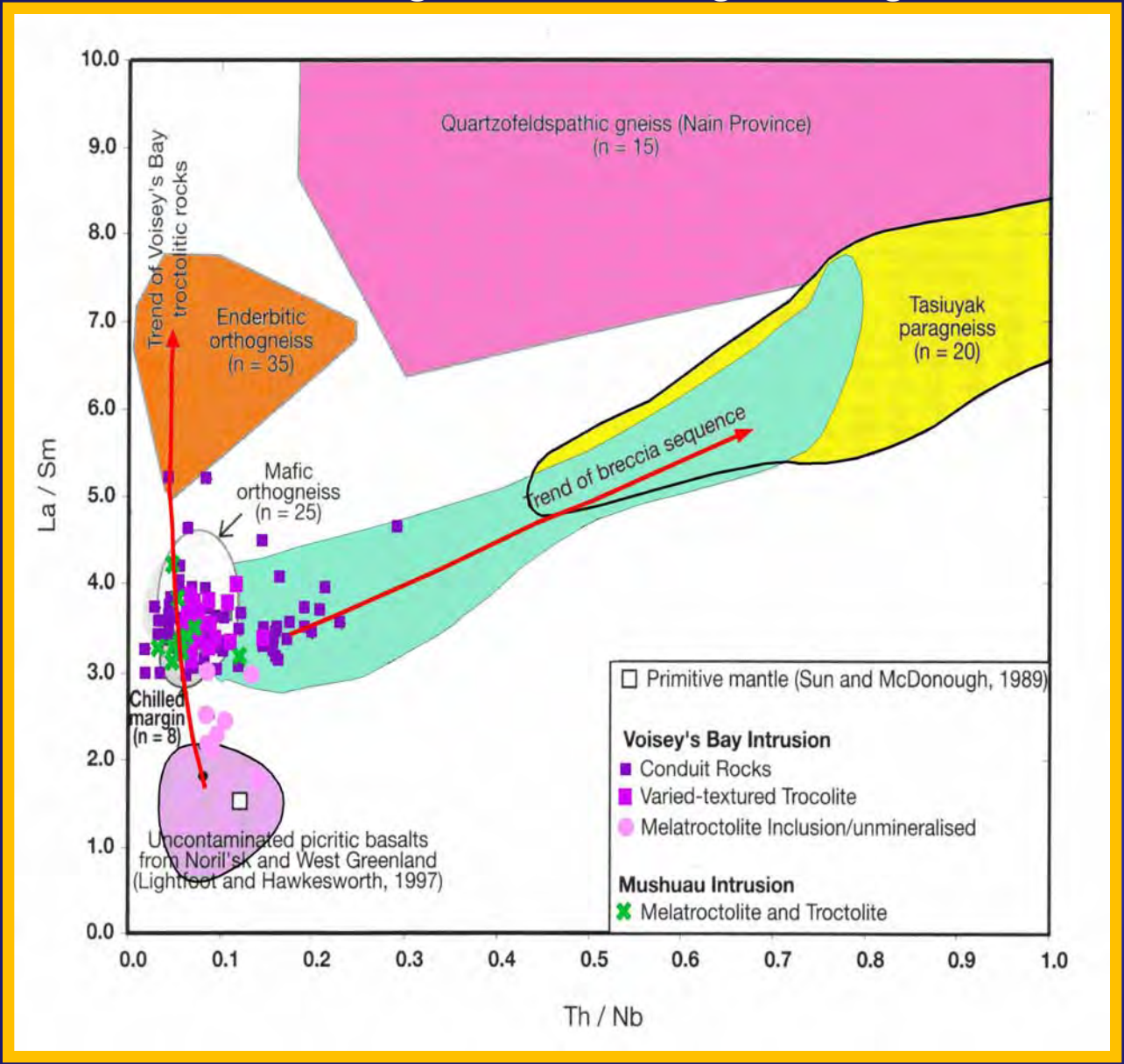
Cross Section at the Entrance of the Feeder to the Upper Chamber
上岩浆房通道入口剖面图

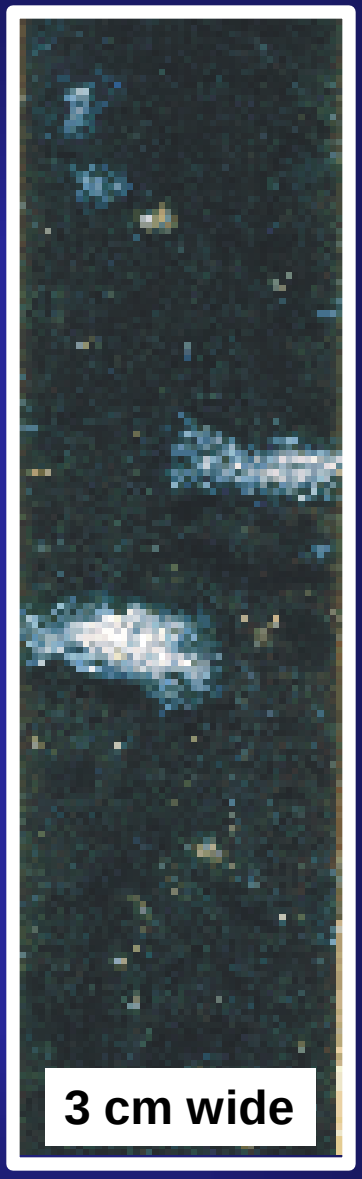


Simplified section through the lower part of the Eastern Deeps Subchamber

La/Sm *vs.* Th/Nb diagram illustrating the stages of contamination

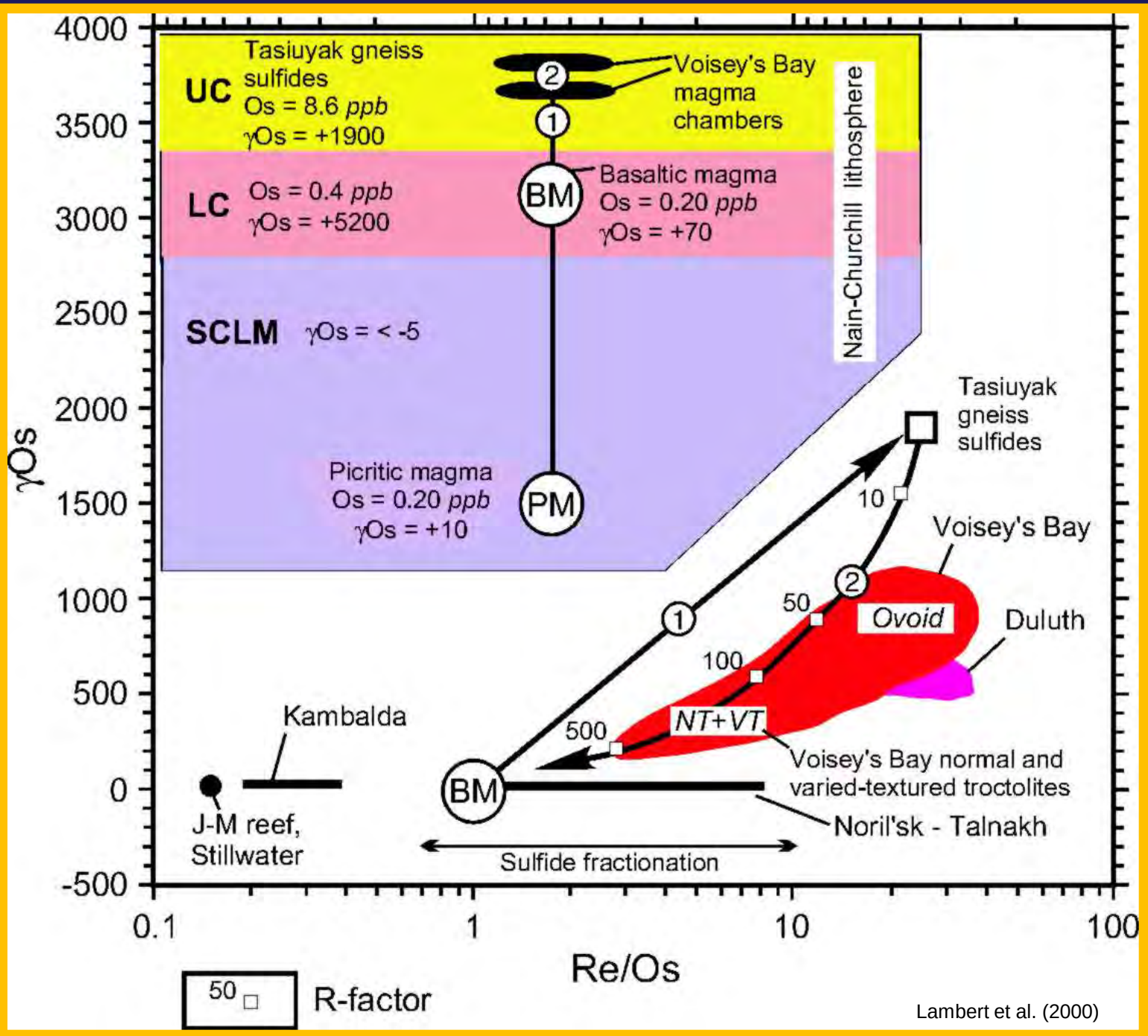
微量元素地壳同化混染证据





Initial mid-crustal contamination of the VB magma was succeeded by contamination by Tasiuyak gneiss, along with some continued contamination by local country rocks. The Mushua intrusion shows little sign of Tasiuyak contamination.

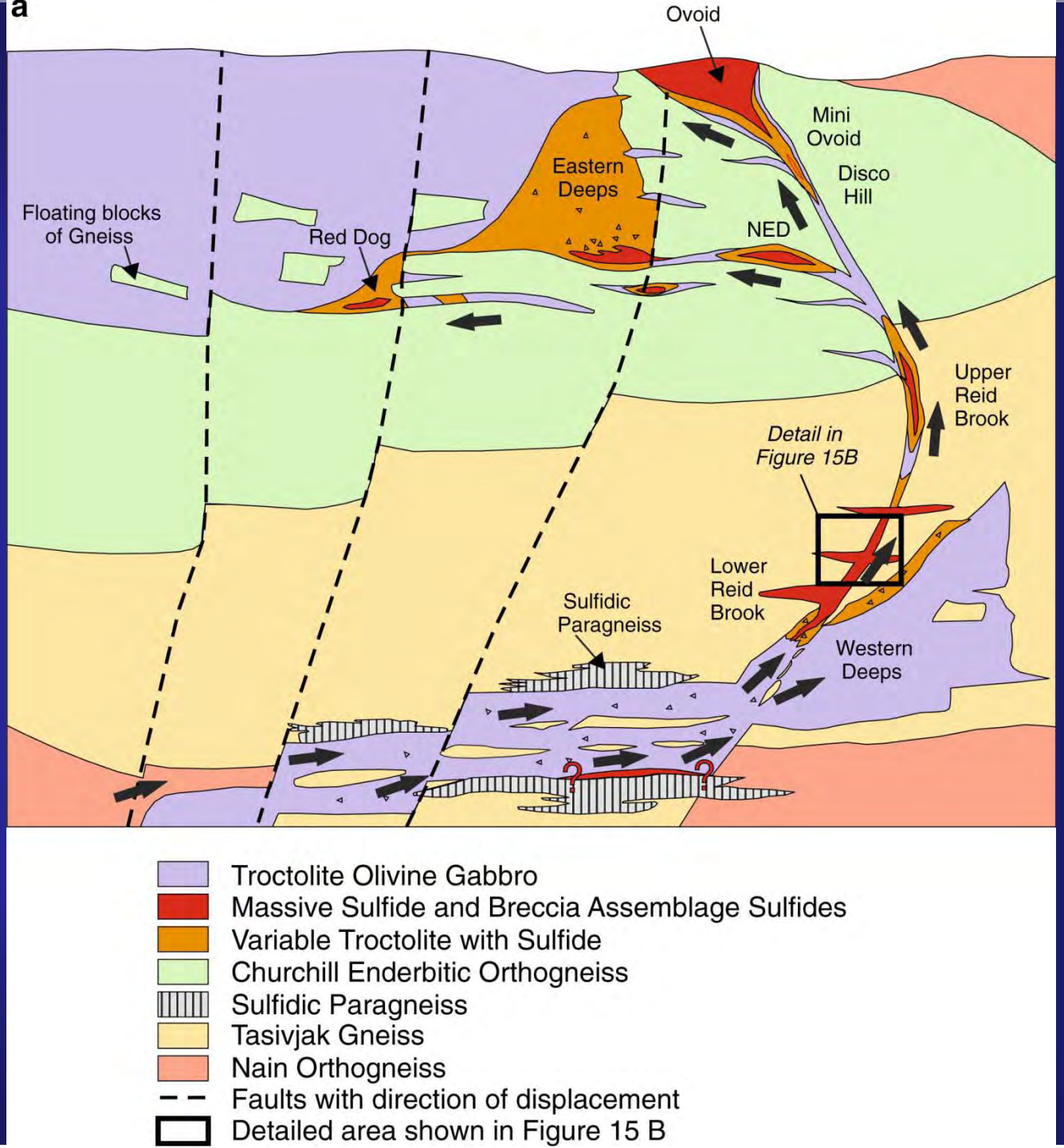
Re-Os 同位素地壳同化混染证据



Lambert et al. (2000)

一个新的成矿模型

Lightfoot et al. 2011



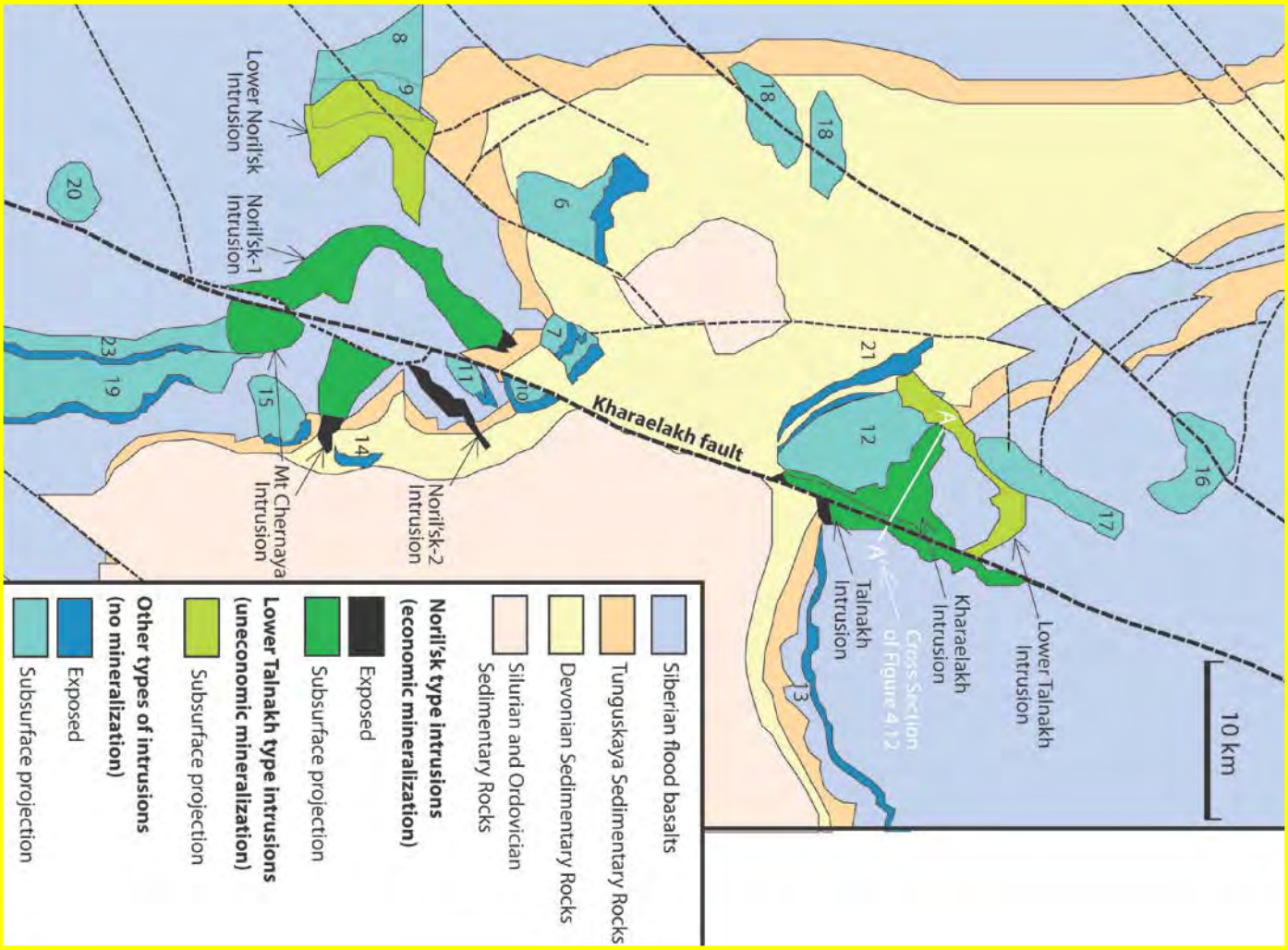
2nd Example: Kharaelakh Deposit

Area of the Siberian Large Igneous Province
西伯利亚大火成岩省的面积

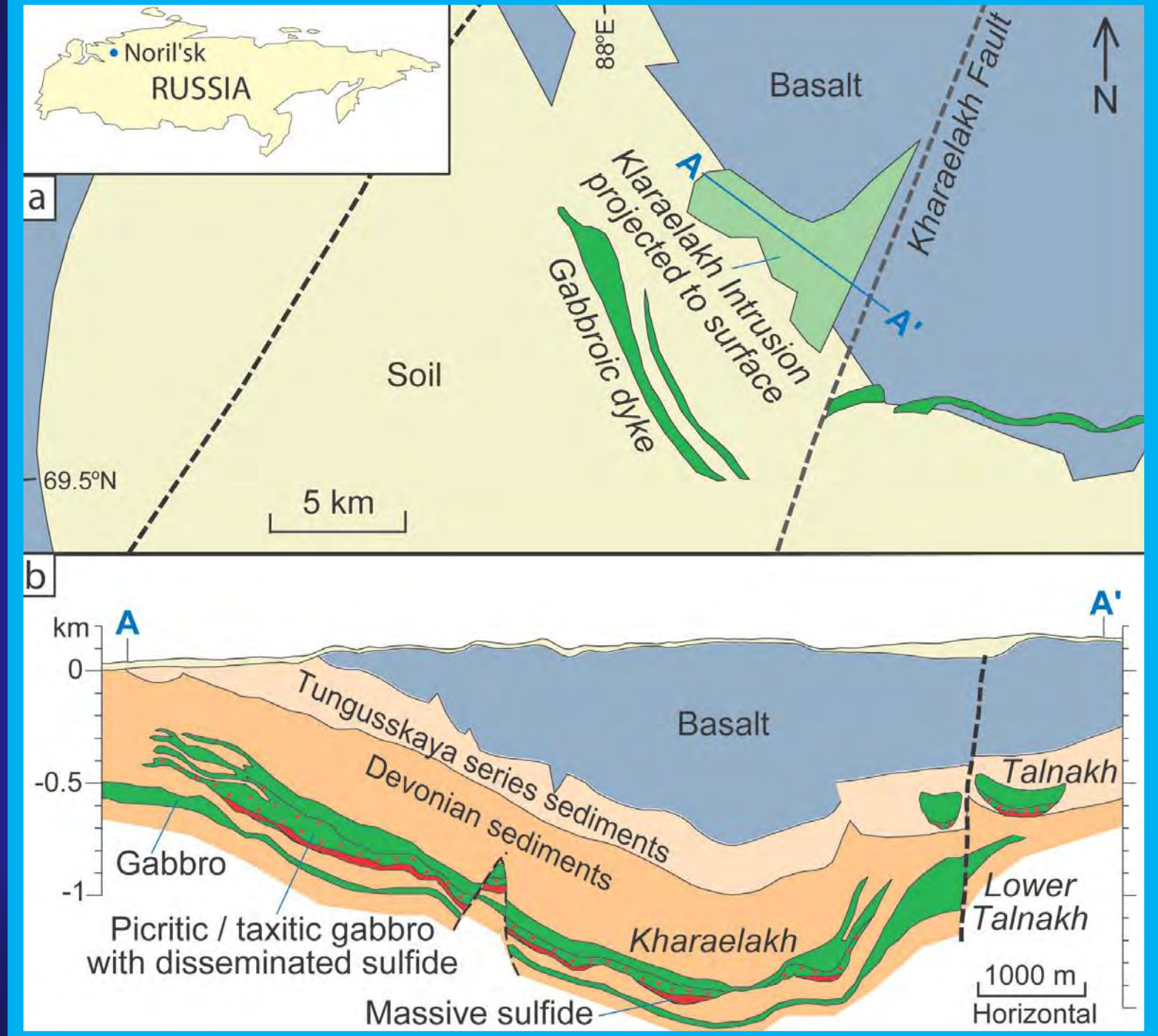


Geological Map of the Noril'sk-Talnakh Region

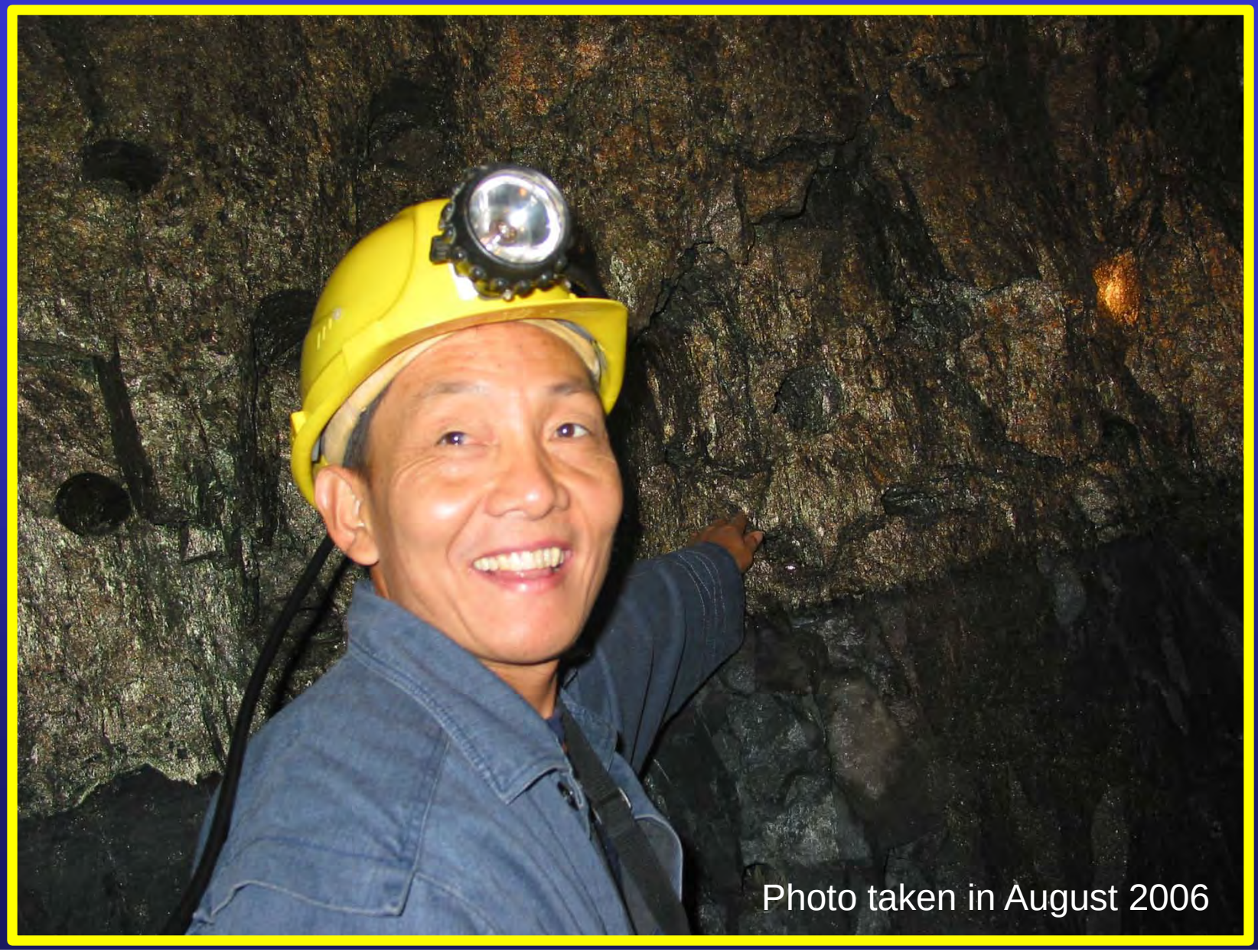
Noril'sk-Talnakh 地区的区域地质图



Plan View and Cross Section of the Kharaelakh Intrusion
Kharaelakh 岩体的平面和剖面图



Evaporite xenoliths within massive sulfide orebody, Skalisty Mine
在 Skalisty 矿山, 块状矿体中含有蒸发岩捕虏体



Sulfide blebs in olivine gabbro
橄榄石辉长岩中珠滴状硫化物



Disseminated sulfide in gabbro
辉长岩中浸染状硫化物

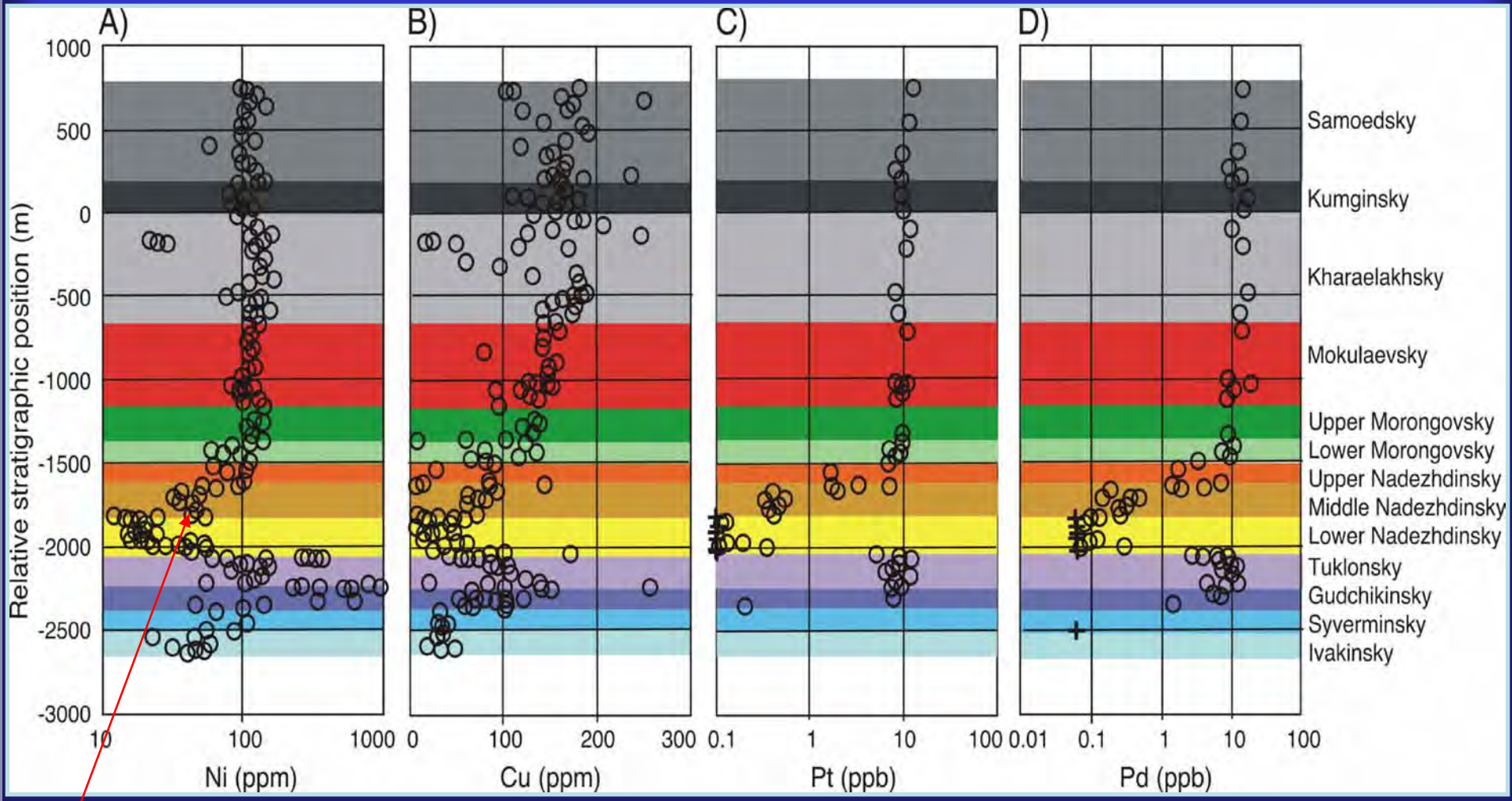


Siberian Flood Basalts 西伯利亚溢流玄武岩



Photo taken in August 2006

Ni, Cu, Pt and Pd contents in Siberian flood basalts
西伯利亚溢流玄武岩中 Ni, Cu, Pt 和 Pd 的含量

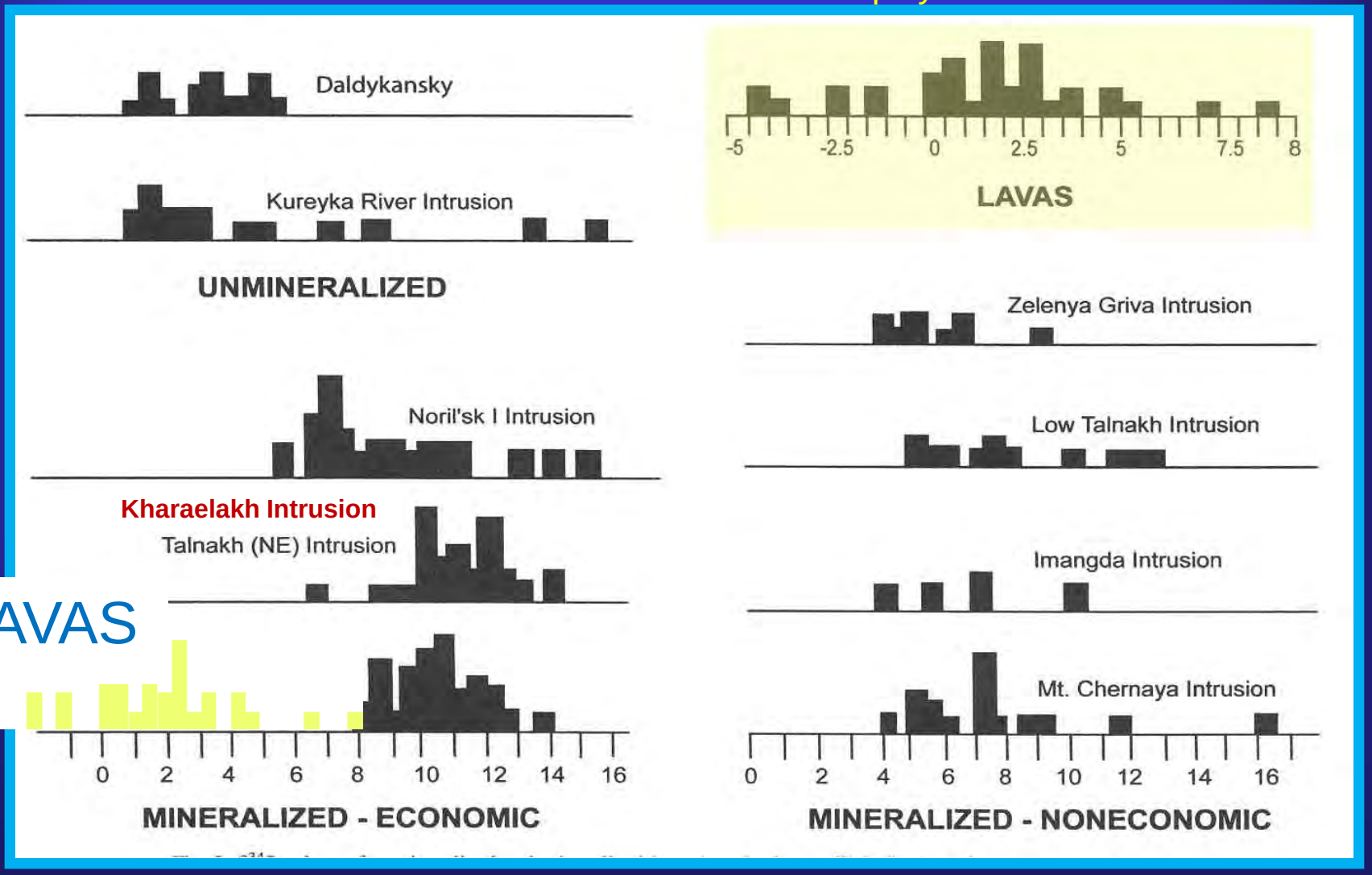


Nadezhdinsky lavas have high La/Sm, high SiO_2, low εNd (not shown), which indicate contamination with granitoid crust. They are also depleted in chalcophile elements, an indication of sulfide segregation

Lightfoot & Keays 2005

Sulfur Isotopes 硫同位素

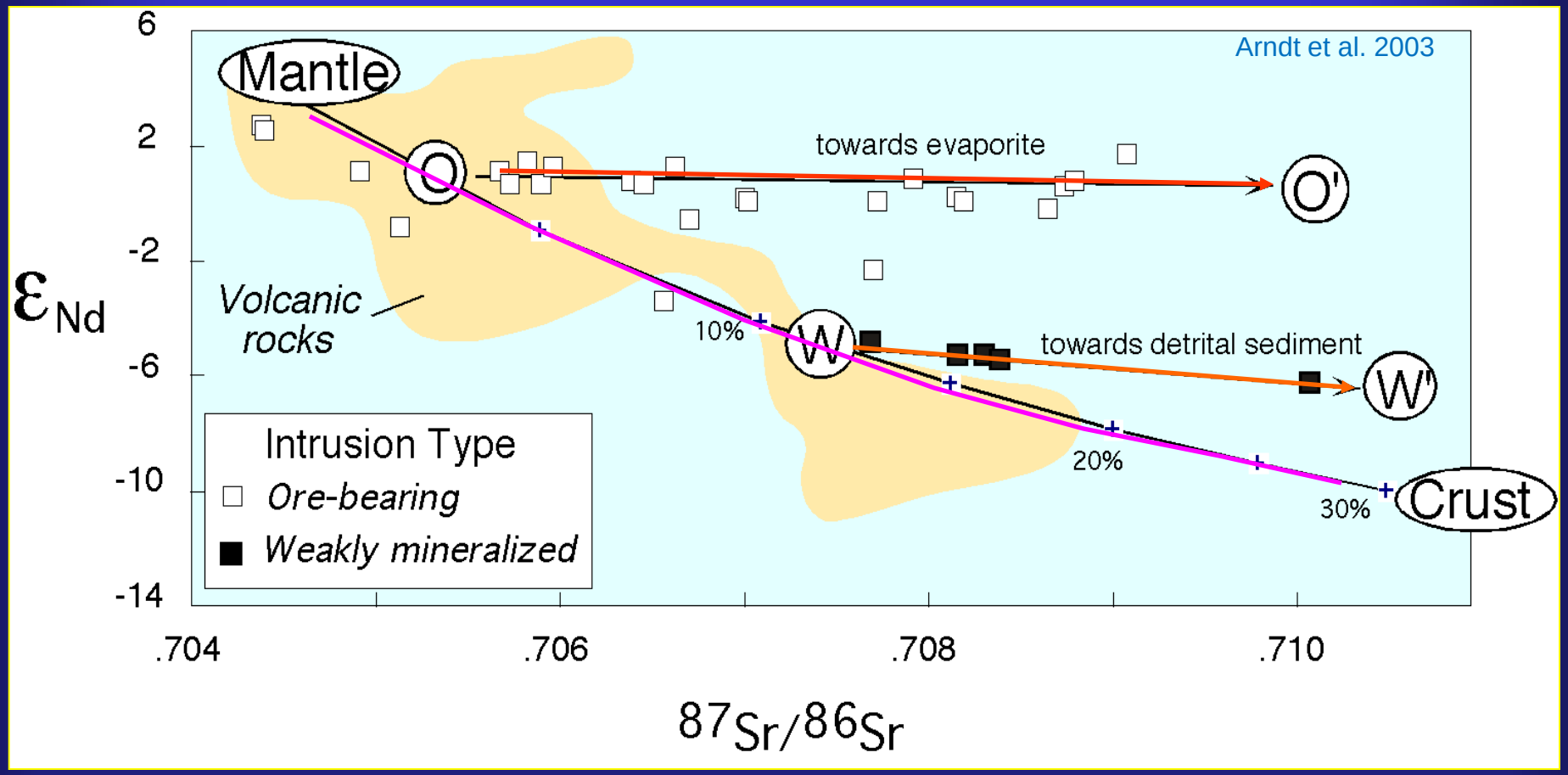
Grinenko 1985



Ripley et al. 2003

Mineralized intrusions have high $\delta^{34}S$ indicating assimilation of evaporite; flood basalts have mantle-like S isotope compositions

Sr-Nd Isotopes (Sr-Nd 同位素)

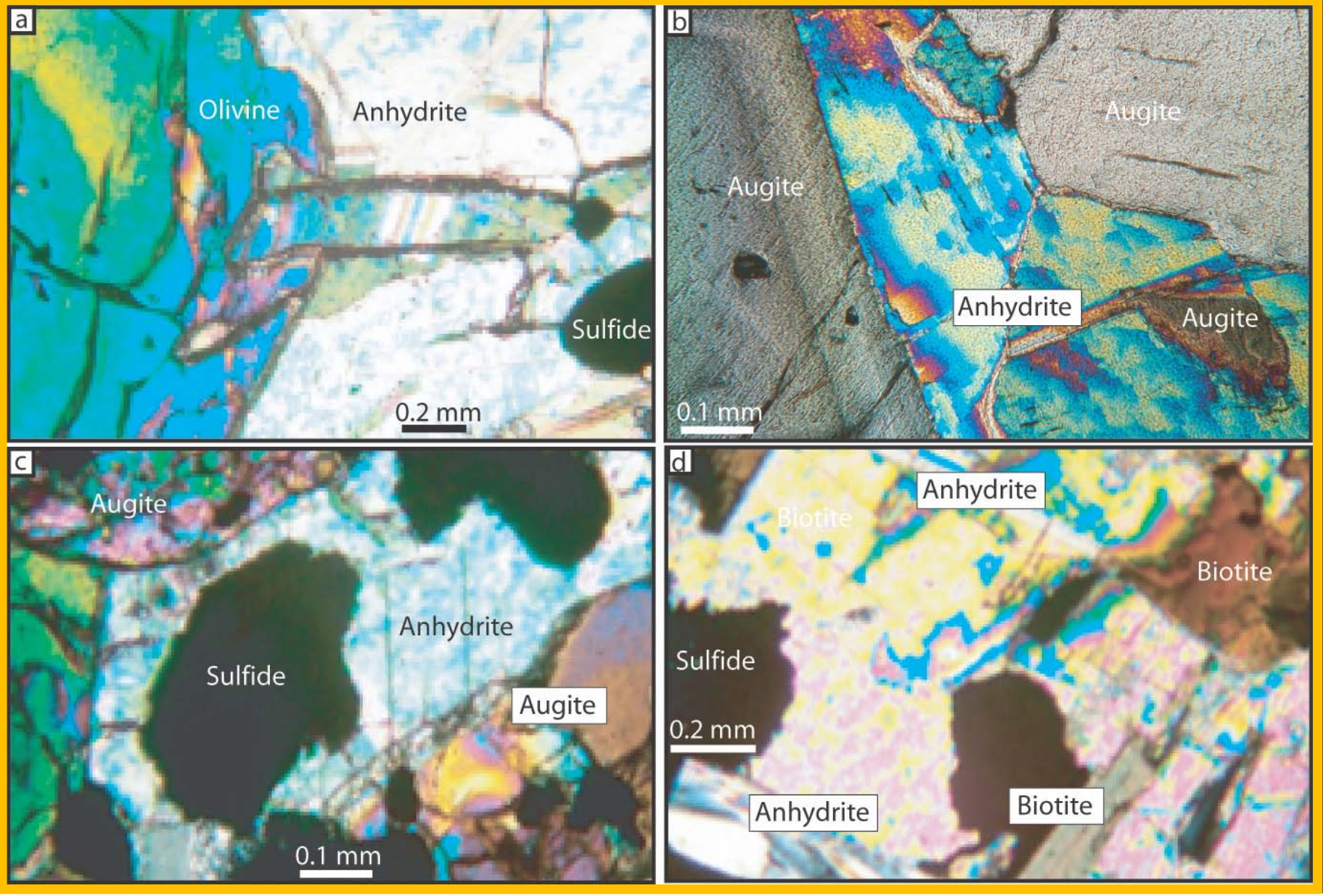


Trend M-C: contamination with old granitoid crust, probably in mid-crustal magma chamber - unrelated to ore formation

Trend O-O': contamination with evaporite - signature of ore formation

Trend W-W': contamination with detrital sediment - unrelated to ore formation

Magmatic Anhydrite
从岩浆结晶出来的硬石膏

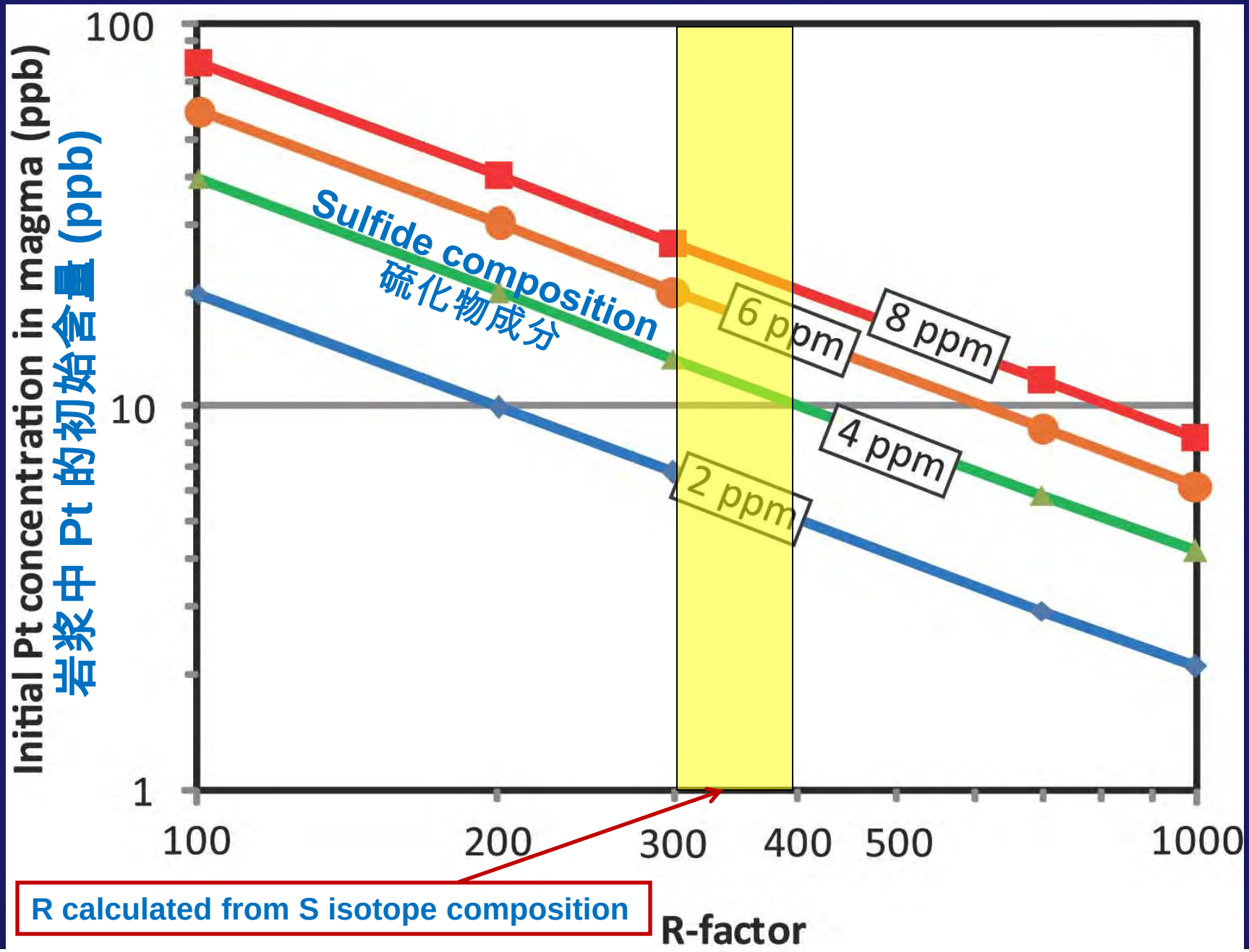


S isotopes of anhydrite-chalcopyrite
硬石膏和黄铜矿的硫同位素

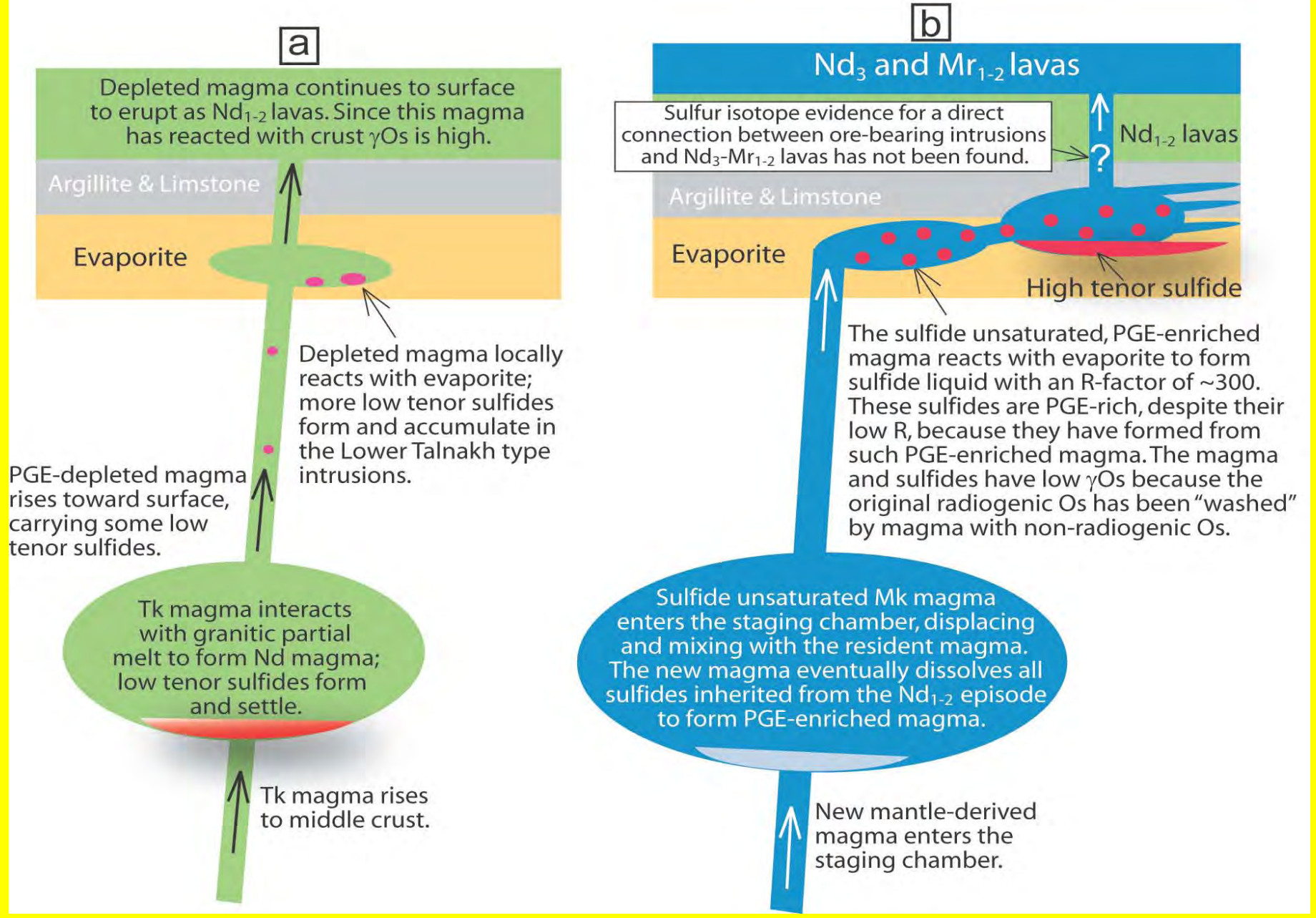
$\delta^{34}S$ values of magmatic anhydrite-sulfide assemblages in the Klaraelakh intrusion, Siberia

Sample	Spot	$\delta^{34}S$ (‰)	$\delta^{34}S$ (‰)
		Anhydrite	Chalcopyrite
KH1	1	22.4	10.4
K58A	1	18.7	9.7
K58A	2	18.9	9.5
K58A	3	18.3	10.3
K58A	4	21.7	10.1
K58B	5	21.2	9.5
K58B	6	19.7	12.0
Average	n = 7	20.1	10.2

Mass Balance 质量平衡



A New Genetic Model 一个新的成矿模型



Exploration of magmatic Ni-Cu deposits in magma conduit system

岩浆通道系统铜镍矿床勘探指南

(1) Olivine-bearing mafic-ultramafic intrusions, large or small

含橄榄石的基性或超基性岩体: 无论大小

(2) S-bearing country rocks surrounding the intrusions or at depth

有含硫地层的存在: 围岩或深处

(3) Change in geometry or lithology wthin the intrusions; xenolith-bearing unit or olivine-rich zone

岩体几何形状变化之处;含有捕虏体或橄榄石富集的岩相带



Please don't hit a wrong target, thank you !

多谢了!