Curriculum Vitae

1988	Baccalauréat C (Science)
1989 – 1991	Math Sup - Math Spe P (Highschool preparatory course)
1991 – 1993	European Highschool of Industrial Chemistry of Strasbourg
1993 – 1994	Licence of Chemistry – University Paris VI
1994 – 1995	Maitrise of Chemistry – University Paris VI Options: Analytical chemistry and Environment
1995 – 1996	D.E.A. of analytical chemistry
1996 – 1997	Ph'D - University of Orleans – Geological Department
1997 – 2002	Ph'D – University of Bayreuth – BGI
2003 – 2006	Pharma consultant
2006 – 2009	Maternity leave

Practicals

EHIC'S practical

- Qualitative and quantitative analysis of a slag (Analytical laboratory - EHIC'S)
- Quality control of the secondary water at the nuclear plant of Dampierre

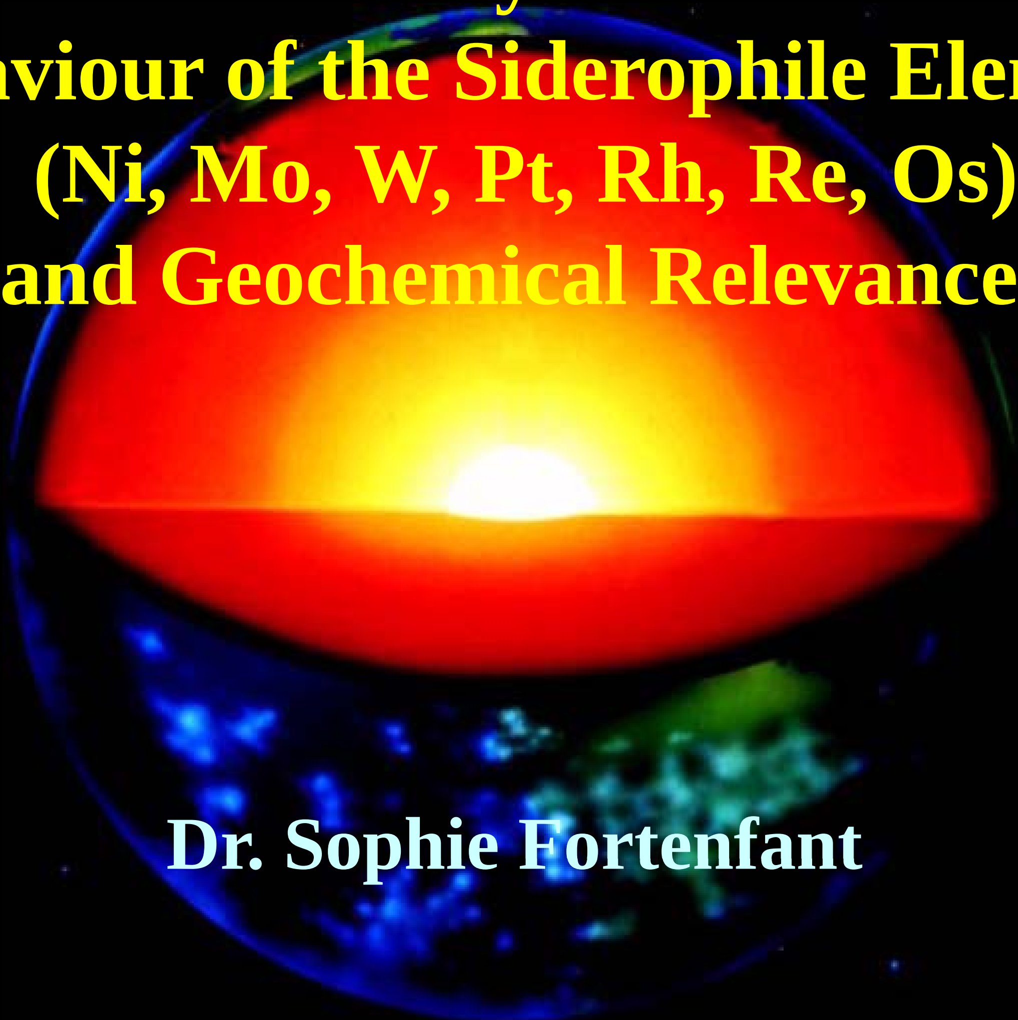
Maitrise practical

- Optimisation of an electrodeposition technique for zinc and cadmium (Ecole Centrale Paris)

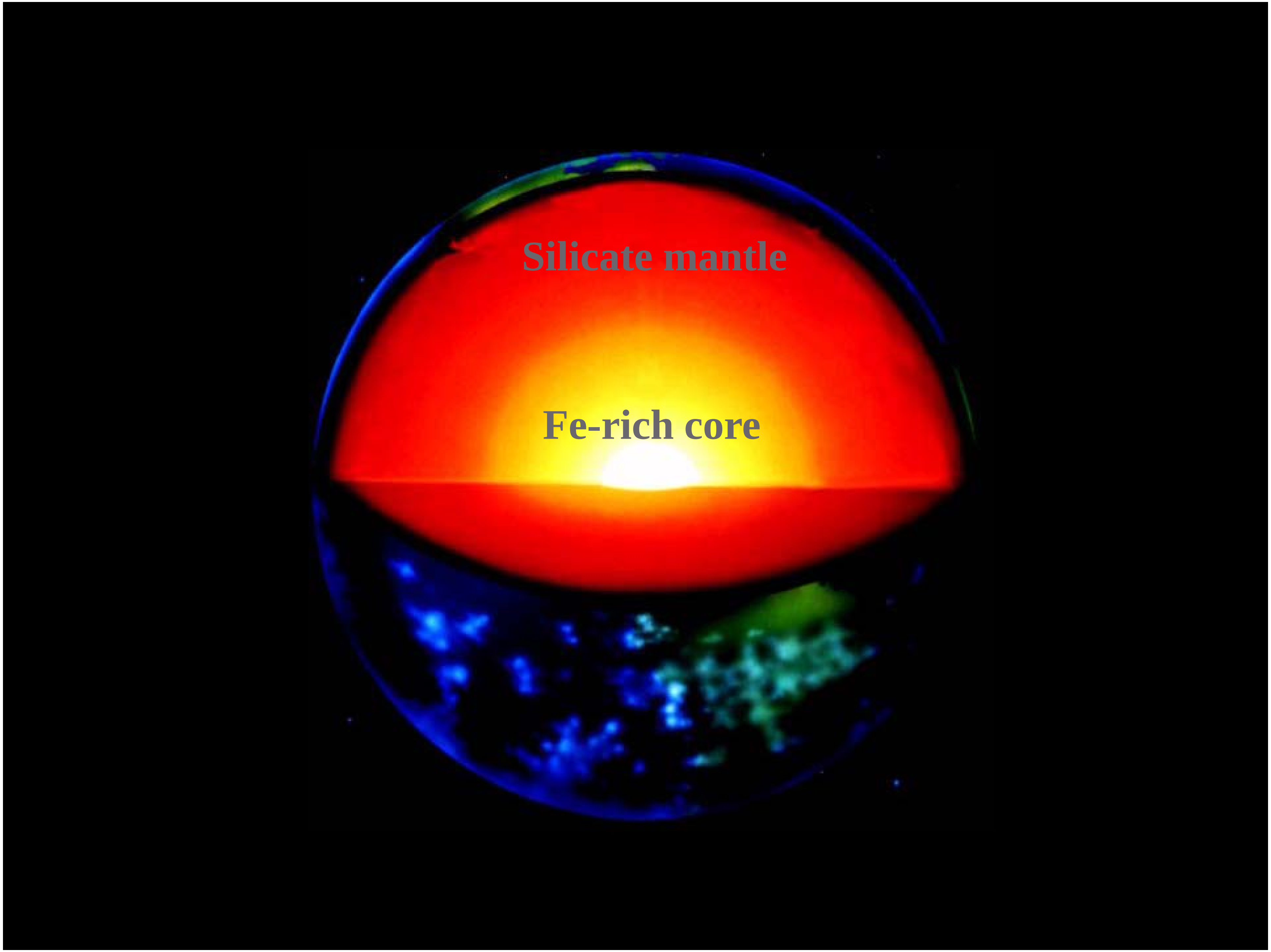
D.E.A practical

- Investigation of the optimal physico-chemical conditions for the electrodeposition of actinides in the presence of boron and calcium (Ecole Centrale Paris)

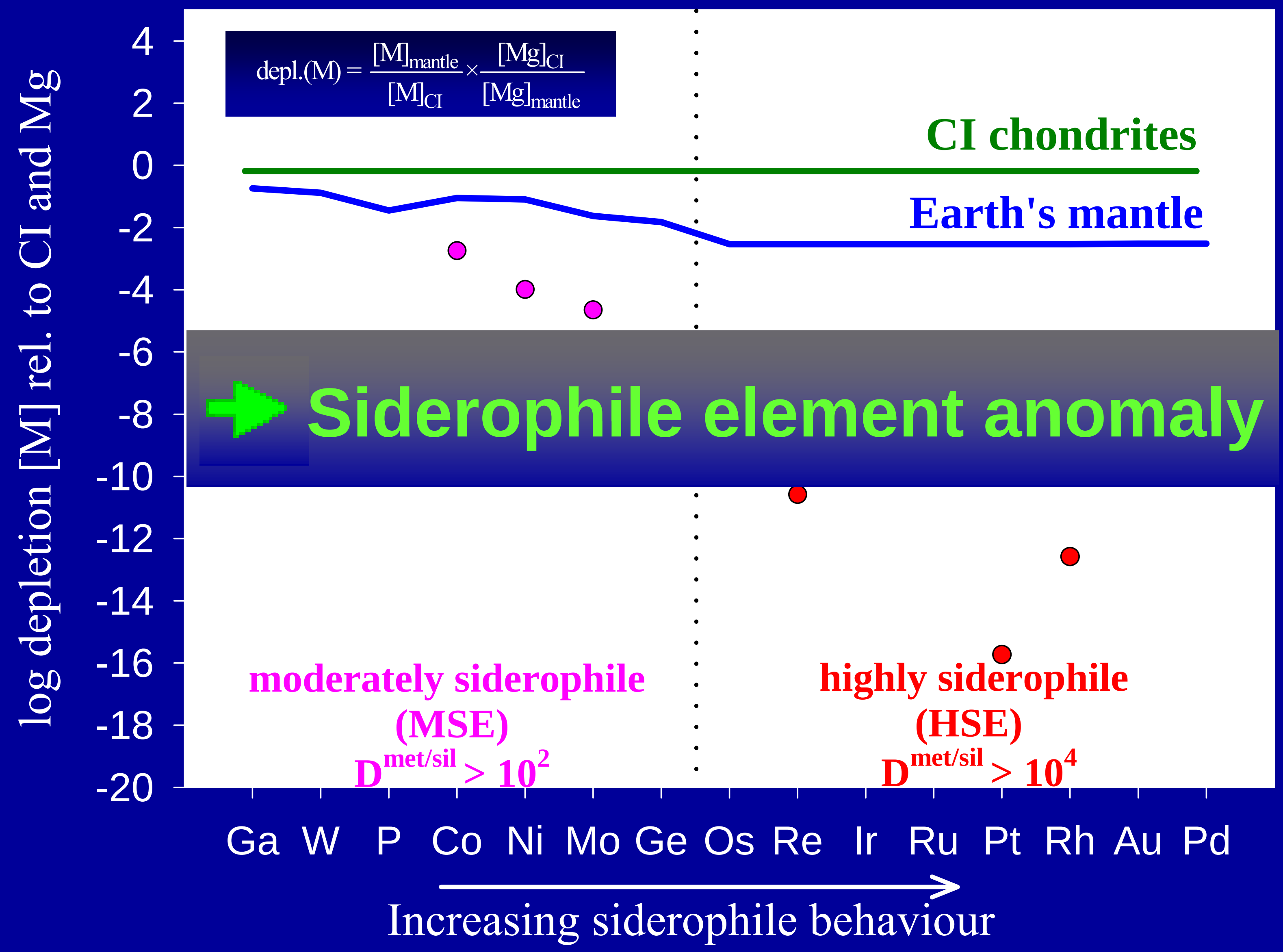
Experimental Study on the Partitioning Behaviour of the Siderophile Elements (Ni, Mo, W, Pt, Rh, Re, Os) and Geochemical Relevances



Dr. Sophie Fortenfant


Silicate mantle
Fe-rich core

Siderophile element depletion



Earth's accretion and core formation models

Late Veneer

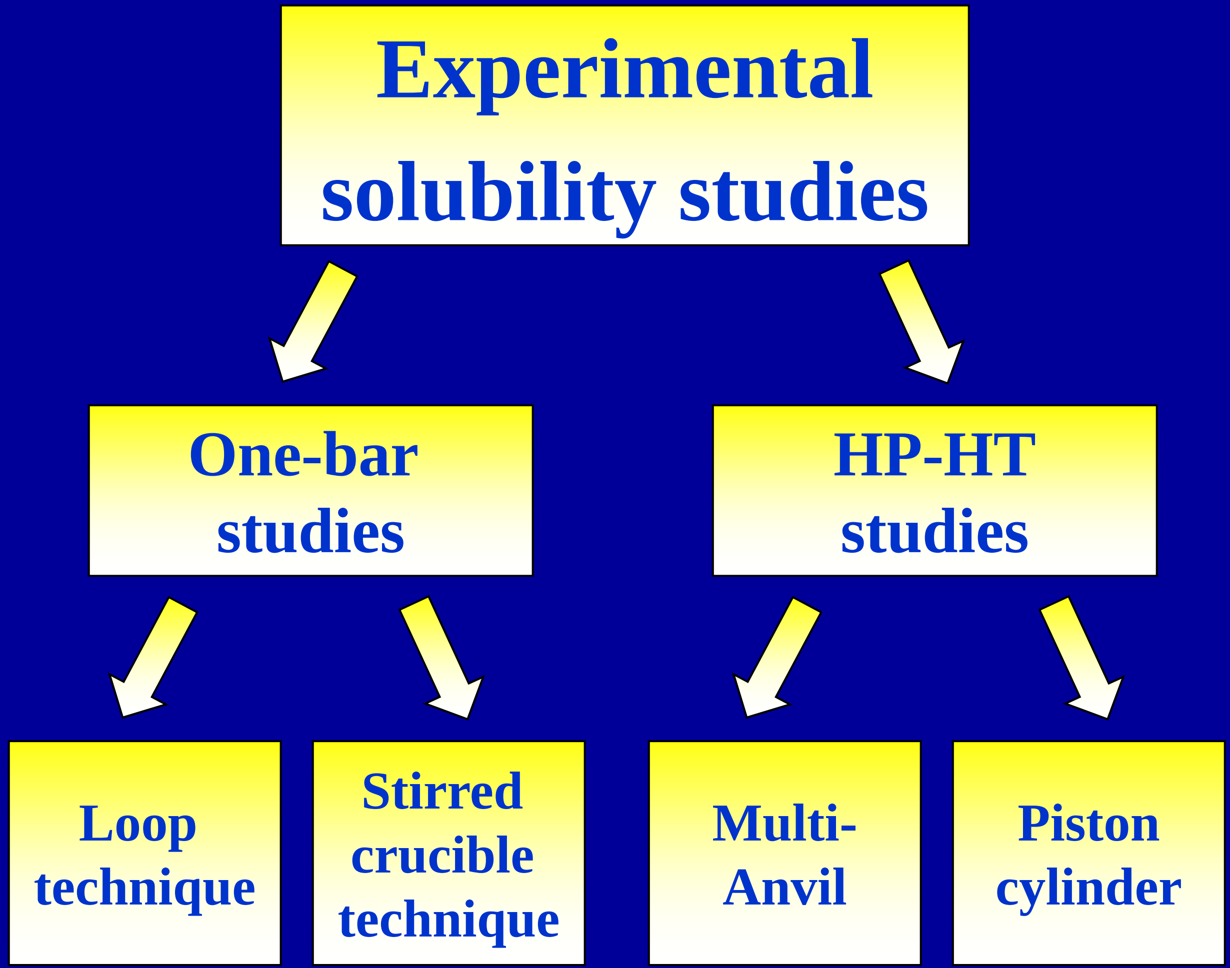
O'Neill (1991)

- Heterogeneous accretion
- The mantle abundances of the MSE is the consequence of a multi-stage core-mantle equilibrium process.
- The elevated and chondritic mantle abundances of the HSE is explained by the addition of a late veneer of chondritic material after core segregation.

Magma Ocean

Li and Agee (1996)
Righter and Drake (1997)

- Homogeneous accretion
- The abundances of the siderophile elements in the Earth's mantle result from core-mantle equilibrium at high pressure and high temperature in a deep magma ocean


Experimental solubility studies
One-bar studies
HP-HT studies
Loop technique
Stirred crucible technique
Multi-Anvil
Piston cylinder

$$\log\,[M] = \frac{x}{4} \times \log fO_2 + \frac{a}{T} + \frac{b \times P}{T} + c \times nbo/t + d$$

Degree of polymerisation of the melt (0<nbo/t<4)

Oxygen fugacity

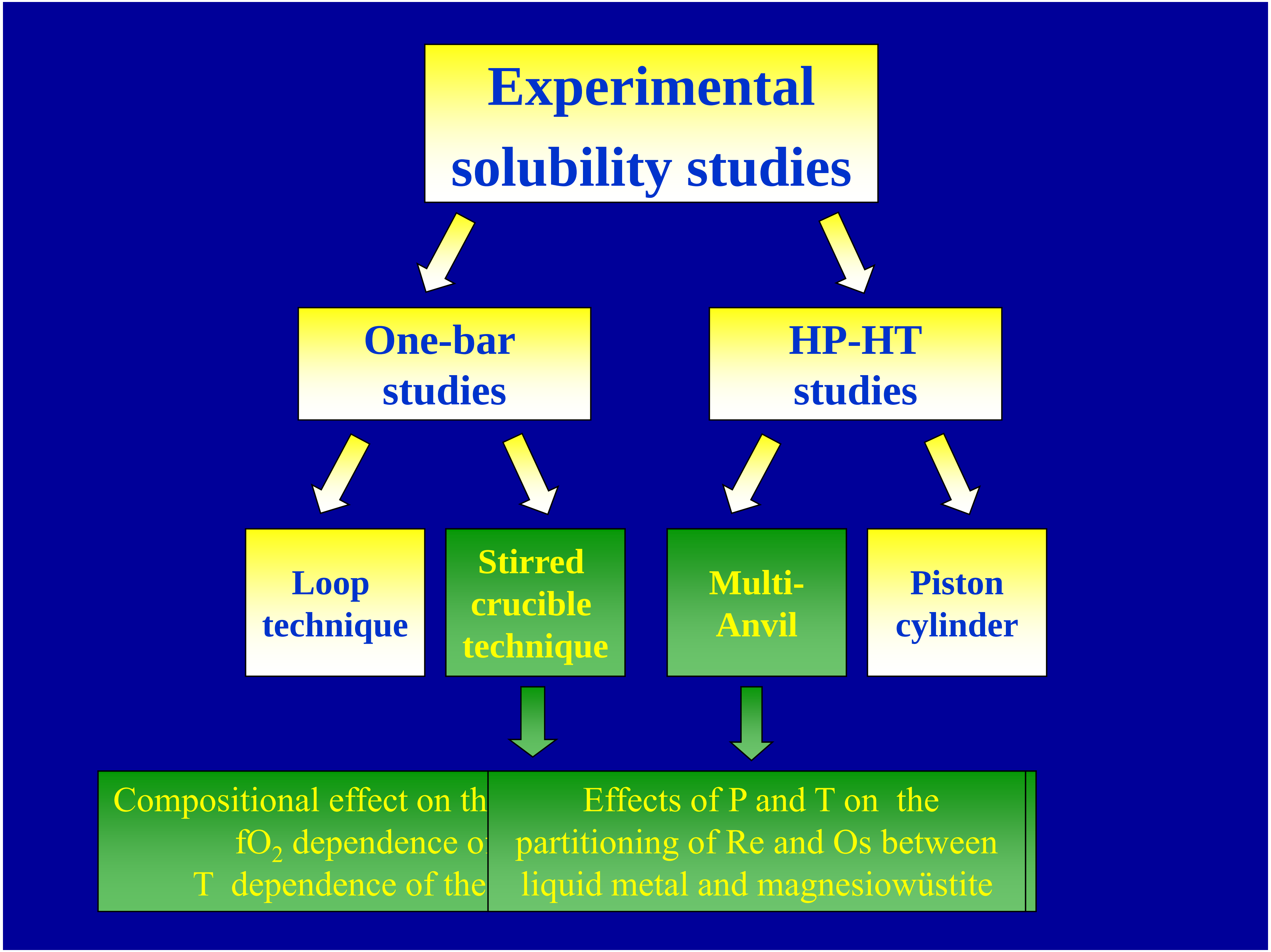
Temperature

Pressure

Previous work

- MSE: the effects of fO_2, T and P on the solubility of these elements in melts are well defined at both low and high pressure, but the compositional effect is not yet well constrained.

- HSE: because of their low solubilities in melts, experimental studies are more difficult. Low-pressure results are often scattered and need to be improved. High-pressure results are rare in the literature.


Experimental solubility studies
One-bar studies
HP-HT studies
Loop technique
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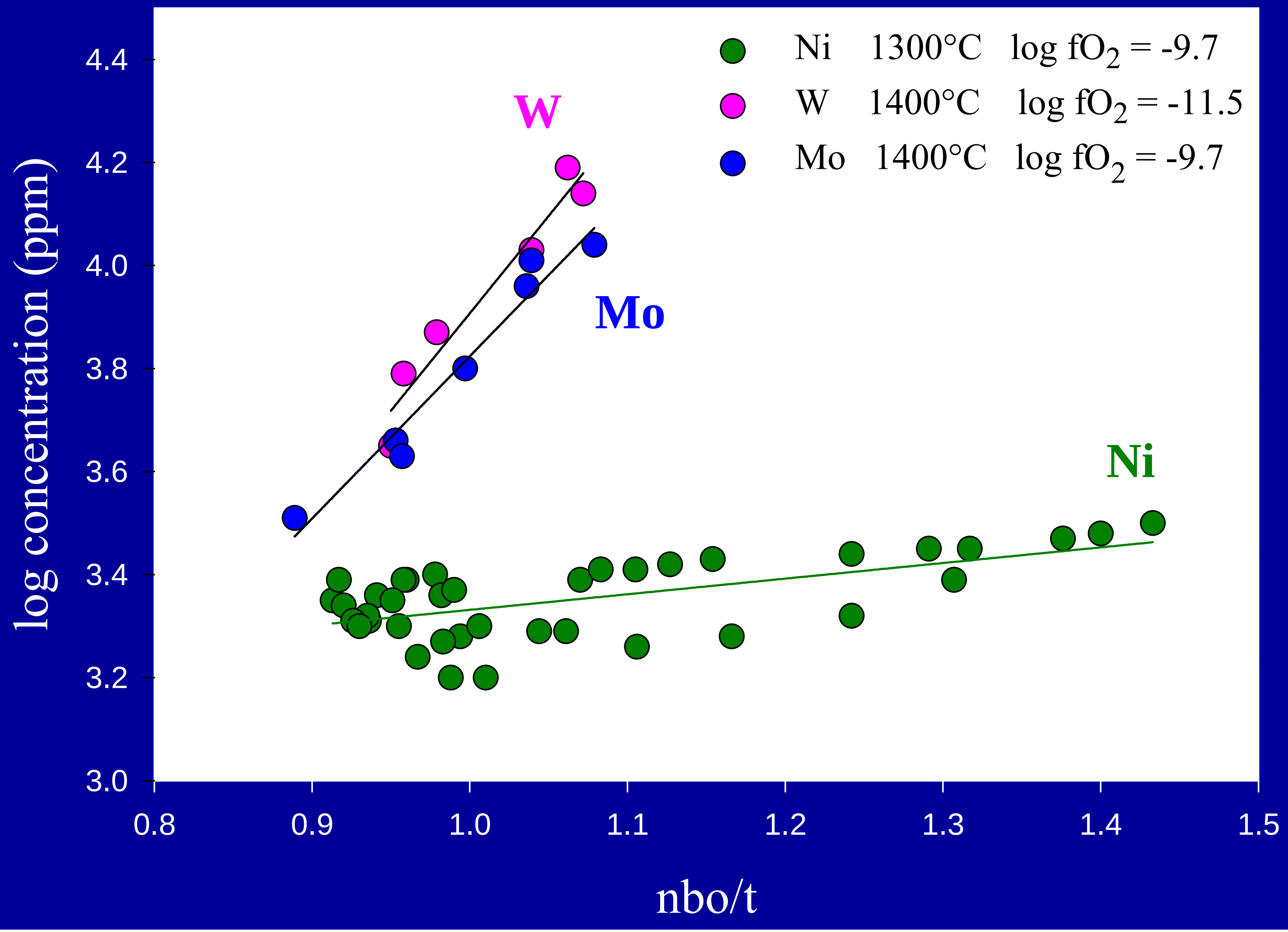
Multi-Anvil
Piston cylinder
Compositional effect on th
fO$_2$ dependence o
T dependence of the
Effects of P and T on the
partitioning of Re and Os between
liquid metal and magnesiowüstite

Compositional effect on the solubilities of Ni, Mo and W at 1 bar



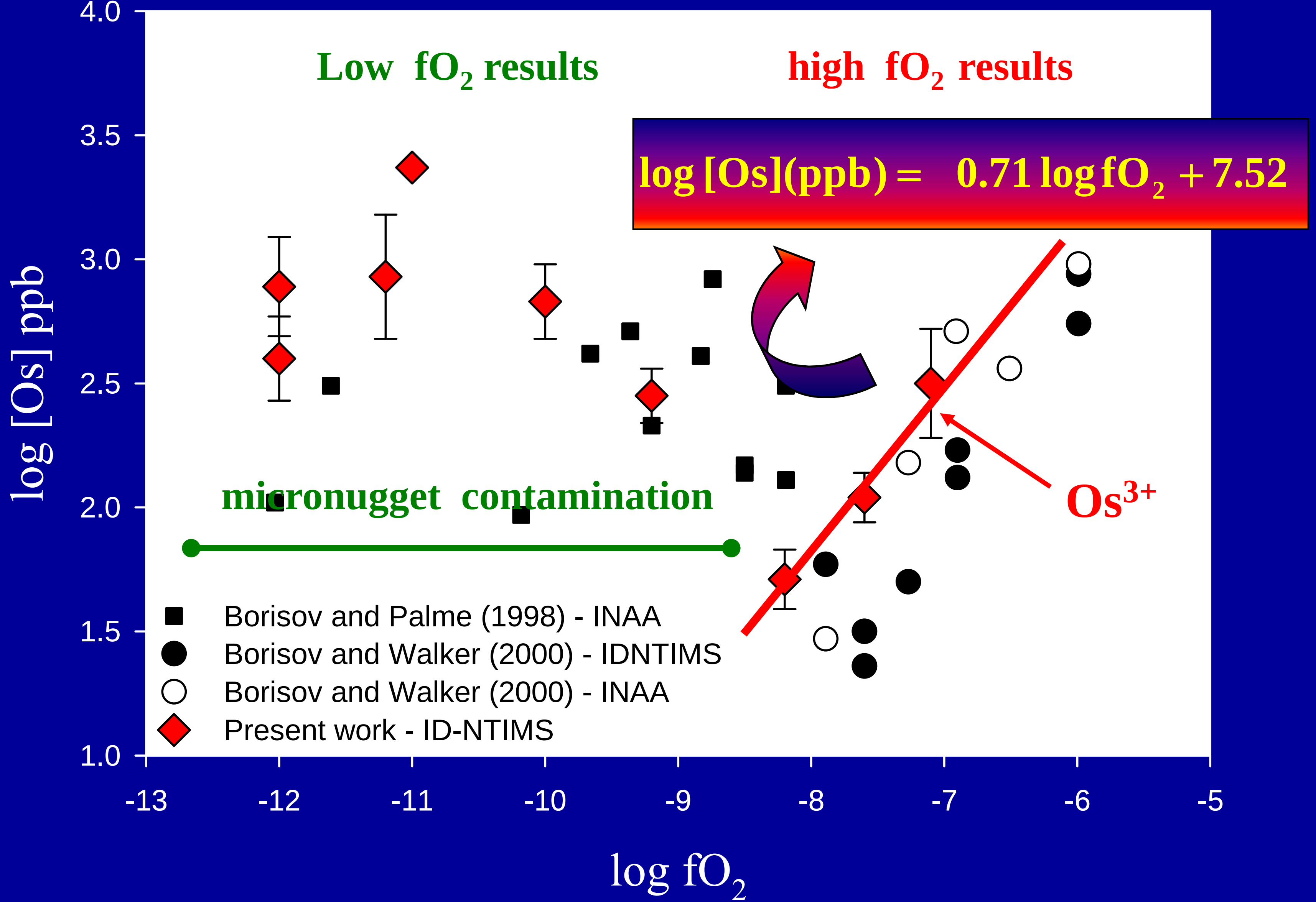
Compositional effect on the solubilities of Ni, Mo and W at 1 bar

Basaltic melt nbo/t ~ 0.9	Peridotitic melt nbo/t ~ 2.5	Assuming core-mantle equilibrium
$D_{Ni}^{met/sil} = \sim 10^2$	$D_{Ni}^{met/sil}$ ↓ 0.5 log-unit	$D_{Ni}^{met/sil} = 15$
$D_{Mo}^{met/sil} = \sim 10^3$	$D_{Mo}^{met/sil}$ ↓ 2 log-units	$D_{Mo}^{met/sil} = 53$
$D_{W}^{met/sil} = \sim 10^2$	$D_{W}^{met/sil}$ ↓ 2 log-units	$D_{W}^{met/sil} = 8$

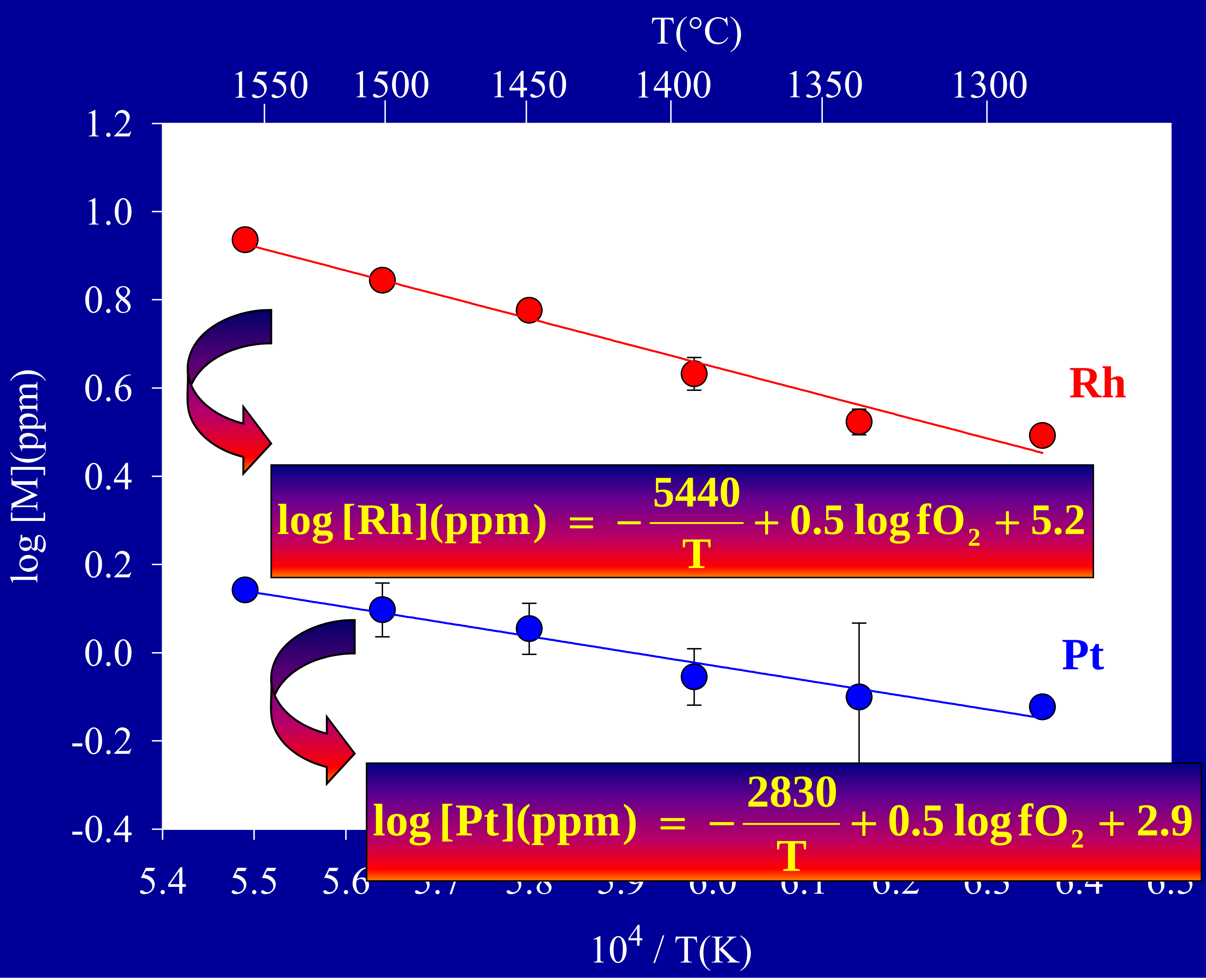
Ni, Mo and W abundances in the Earth‘s mantle could result from HP-HT equilibrium between peridotitic melt and metal.

→ **Magma ocean**

Oxygen fugacity dependence of the solubility of Os at 1 bar



Temperature dependence of the solubilities of Pt and Rh at 1 bar



1-bar solubility results for Os, Pt and Rh

$$\log\,[Os](ppb) = 0.71 \log fO_2 + 7.52$$

$$\log\,[Pt](ppm) = -\frac{2830}{T(K)} + 0.5 \times \log fO_2 + 2.9$$

$$\log\,[Rh](ppm) = -\frac{5440}{T} + 0.5 \times \log fO_2 + 5.2$$

$$D_M^{core/mantle} = \frac{1}{A \times [M]_{T,fO_2} \times \gamma_M^{Fe\,liq,\infty}}$$

Solubility of M at T and fO_2 conditions relevant to core formation (3000K, $10^{-4.5}$ bars)

Thermodynamic data of the Fe-M system

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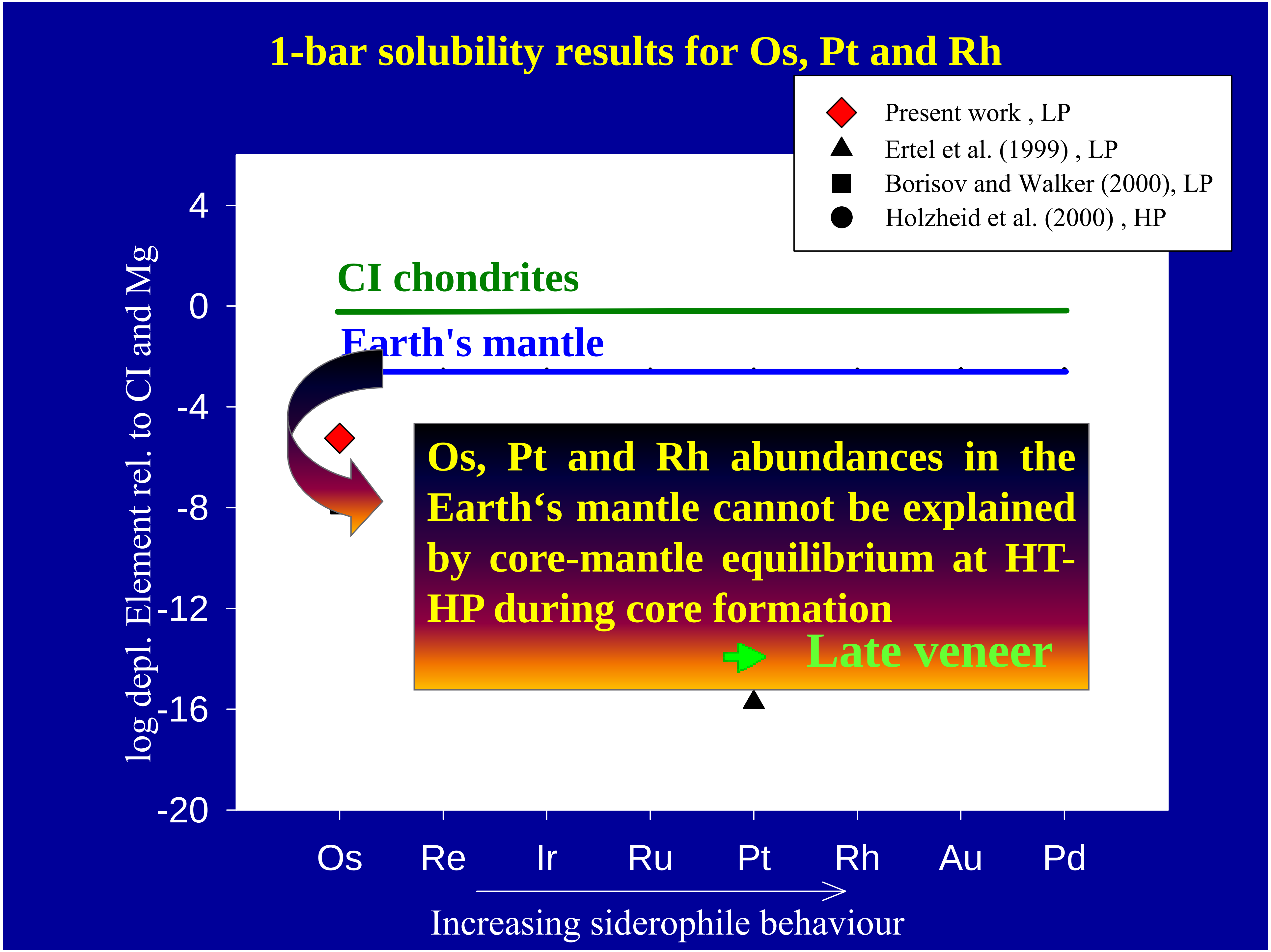
$$[M]_{mantle} = \frac{[M]_{CI}}{(0.32 D_M^{core/mantle} + 0.68)}$$


1-bar solubility results for Os, Pt and Rh
Present work , LP
Ertel et al. (1999) , LP
Borisov and Walker (2000), LP
Holzheid et al. (2000) , HP
CI chondrites
Earth's mantle
Os, Pt and Rh abundances in the Earth‘s mantle cannot be explained by core-mantle equilibrium at HT-HP during core formation
Late veneer
log depl. Element rel. to CI and Mg
4
0
-4
-8
-12
-16
-20
Os
Re
Ir
Ru
Pt
Rh
Au
Pd
Increasing siderophile behaviour

HP-HT liquid metal-magnesiowüstite partitioning of Re and Os

- During a HP-HT multi-anvil experiment, the oxygen fugacity is not directly measured.

- To interpret the data on the partitioning of an element M between liquid metal and oxide at high pressure and high temperature, it is common to use the two-component distribution coefficient KD_M:

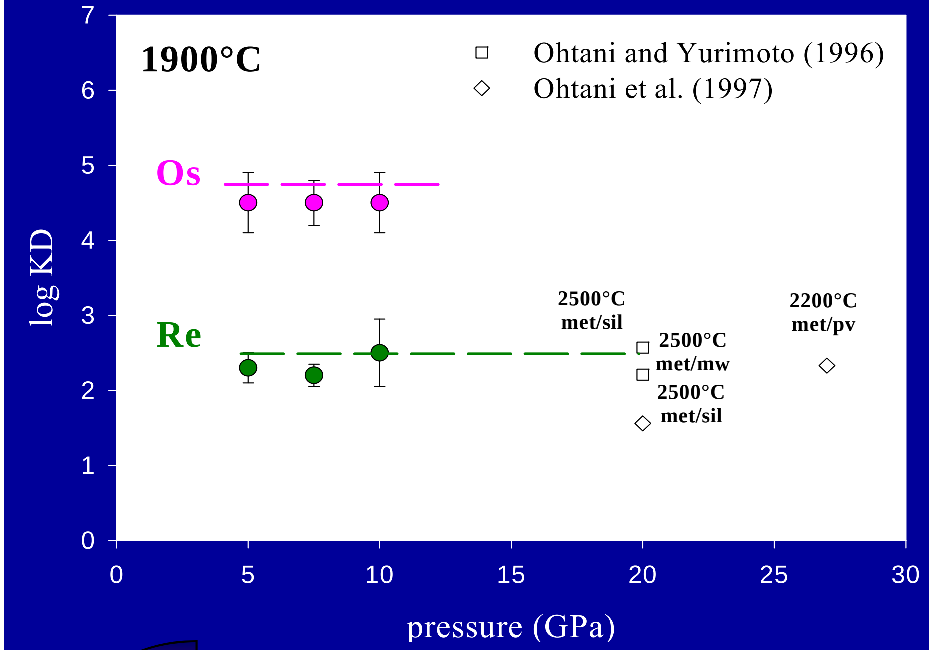
$$KD_M = \frac{D_M^{met/ox}}{\left(D_{Fe}^{met/ox}\right)^{x/2}} = \frac{[M]}{[MO_{x/2}]} \times \frac{[FeO]^{x/2}}{[Fe]^{x/2}}$$

which describes the distribution reaction

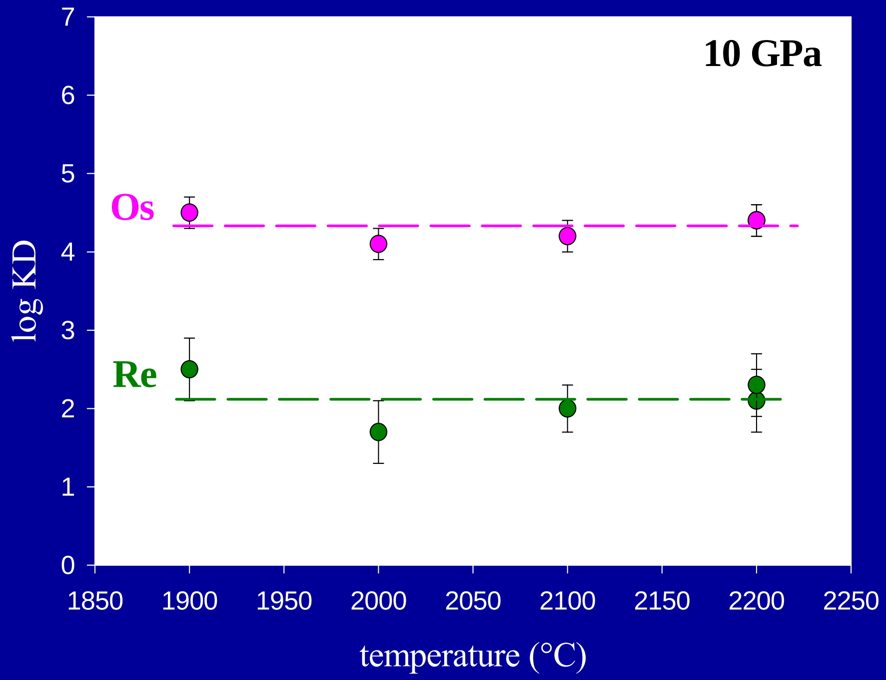
$$MO_{x/2} + x/2\ Fe \leftrightarrow M + x/2\ FeO$$

➡ **KD_M is independent of fO_2**

HP-HT liquid metal-magnesiowüstite partitioning of Re and Os



No temperature dependence



No pressure dependence

HP-HT liquid metal-magnesiowüstite partitioning of Re and Os

Experimental results → $\log KD^{met/mw}_{Os} \approx 4.1 - 4.5$

$\log KD^{met/mw}_{Re} \approx 1.8 - 2.5$

Values calculated assuming core-mantle equilibrium → $\log KD^{met/mw}_{Os} = 2$

$\log KD^{met/mw}_{Re} = 1.6$

→ ~~core-mantle equilibrium~~

General Conclusions

- MSE: based on the results from the 1 bar study on the compositional effect on the solubilities of Ni, Mo and W in melts, **the abundances of these MSE in the Earth's mantle could be the result of core-mantle equilibrium at HP-HT in a deep magma ocean of peridotitic composition**.

- HSE: based, on the one hand, on the solubility results for Os, Pt and Rh obtained at 1 bar and on the HP/HT results on the partitioning of Re and Os between liquid metal and magnesiowüstite on the other hand, **equilibrium between core and mantle during core formation cannot explain the abundances of Re, Os, Pt and Rh in the Earth's mantle**. **The elevated and chondritic abundances of the highly siderophile elements observed in the Earth's mantle remain better explained by the addition of a late veneer of chondritic material after core segregation**.

Current research

Polysulfide as intermediate sulfur species are important for electron transfer processes in anoxic aquifers

1. Development of an analytical method for polysulfide identification and quantification
2. Determination of the importance of polysulfides as electron schuttles during microbial reduction of ferrihydrite by sulfurospirillum deleyianum
3. Determination of the importance of polysulfides as electron donors and acceptors in different anoxic sulfur redox processes