Water-saturated solidus and second critical endpoint of peridotite determined from liquid textures and chemistry

Jintuan Wang[1*], Eiichi Takahashi[1], Xiaolin Xiong[1]

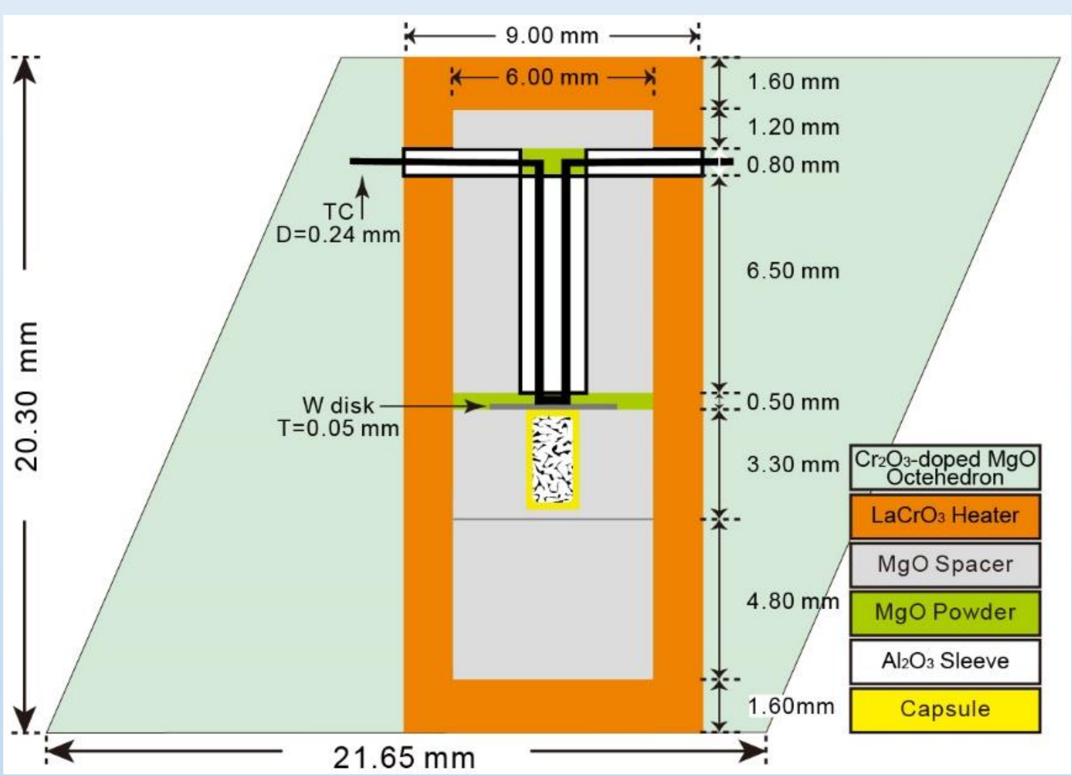
([1] Guangzhou Institute of Geochemistry, Chinese Academy of Sciences; *Presenting Author: wangjt@gig.ac.cn)

1. Introduction

- Hydrous melting of peridotite is the essential process in magma genesis at subduction zones.
- Water-saturated ('wet') solidus of mantle peridotite defines initial melting temperature of the mantle under water-saturated conditions and the second critical endpoint (SCEP) marks the end of the wet solidus.
- However, published wet solidus shows a difference of 200−600 °C at given pressures, meanwhile, reported SCEP ranges from < 4 to > 6 GPa.

2. High Pressure Experiments

To determine the wet solidus and SCEP, melt and fluid chemistry



KLB-1 + 10 wt% H_2O;

950–1200 °C, 3–6 GPa;

2500 ton Multi-anvils;

Tokyo Institute of Technology

⇩

Guangzhou Institute of Geochemistry

25M (25mm edge length MgO octahedron) with **$LaCrO_3$ furnace**

- Homogeneous temperature distribution (< 20 °C) ;
- Rapid quench rate.
- Isotropic decompression

⇨ (good preservation of delicate fluid textures)

3. Diagnostic Criterions

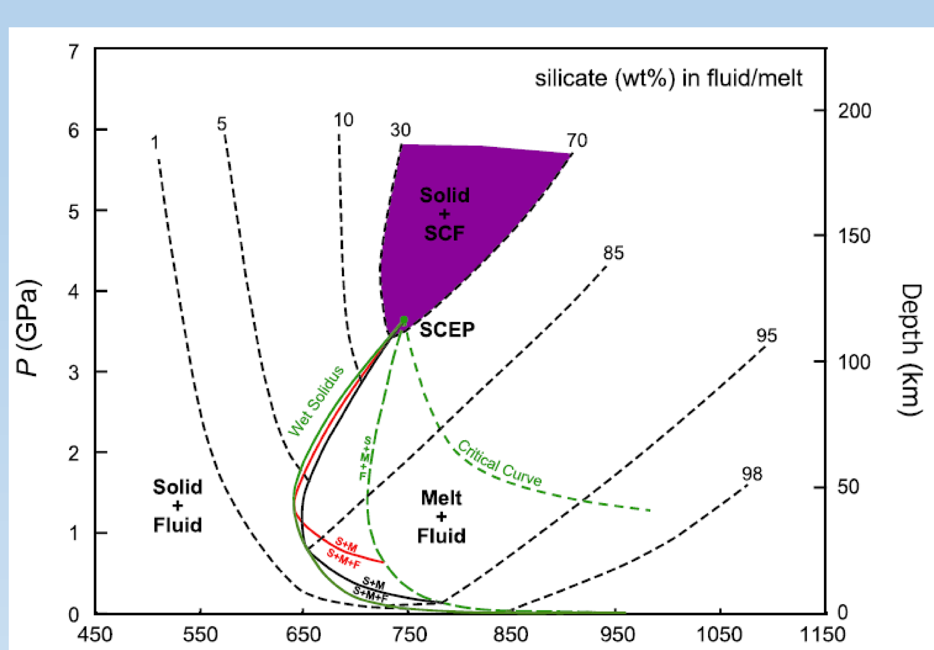
Below P_C

$T<T_{solidus}$, **minerals + fluid**;

$T>T_{solidus}$, **mineral + melt + fluid**

Above P_C

minerals+SCF;



Ni et al. (2017)

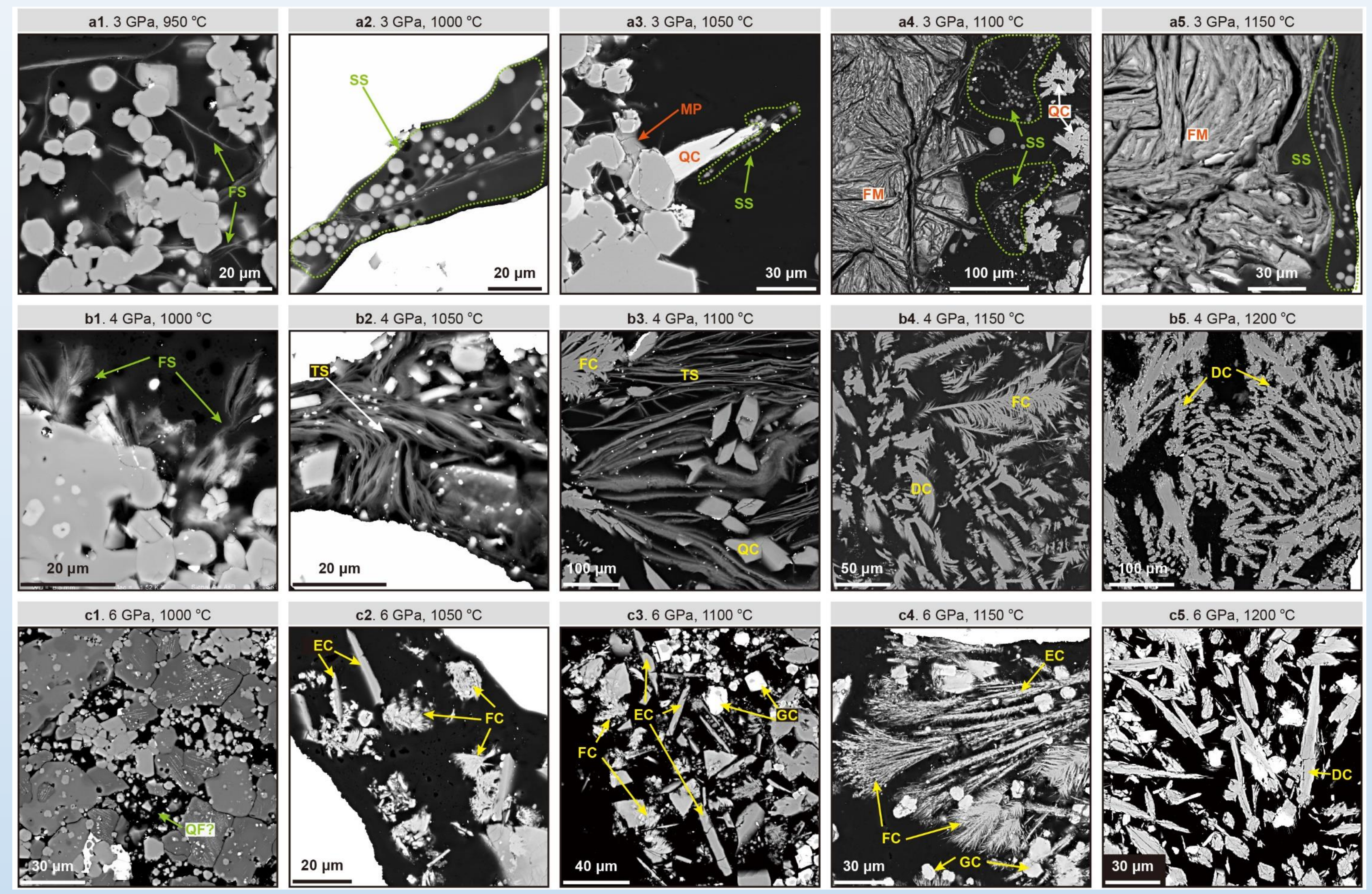
4. Textures of quenched melt and fluid

Fluid: $T<T_{solidus}$, fragile sheet (**FS**); $T>T_{solidus}$, sheet + spherule (**SS**);

Melt: melt pocket (**MP**), quenched crystal (**QC**); felt-like masses (**FM**) etc.

SCF: homogeneous phase *Adam et al. (1997, 2014); Mibe et al.(2007,2011)*

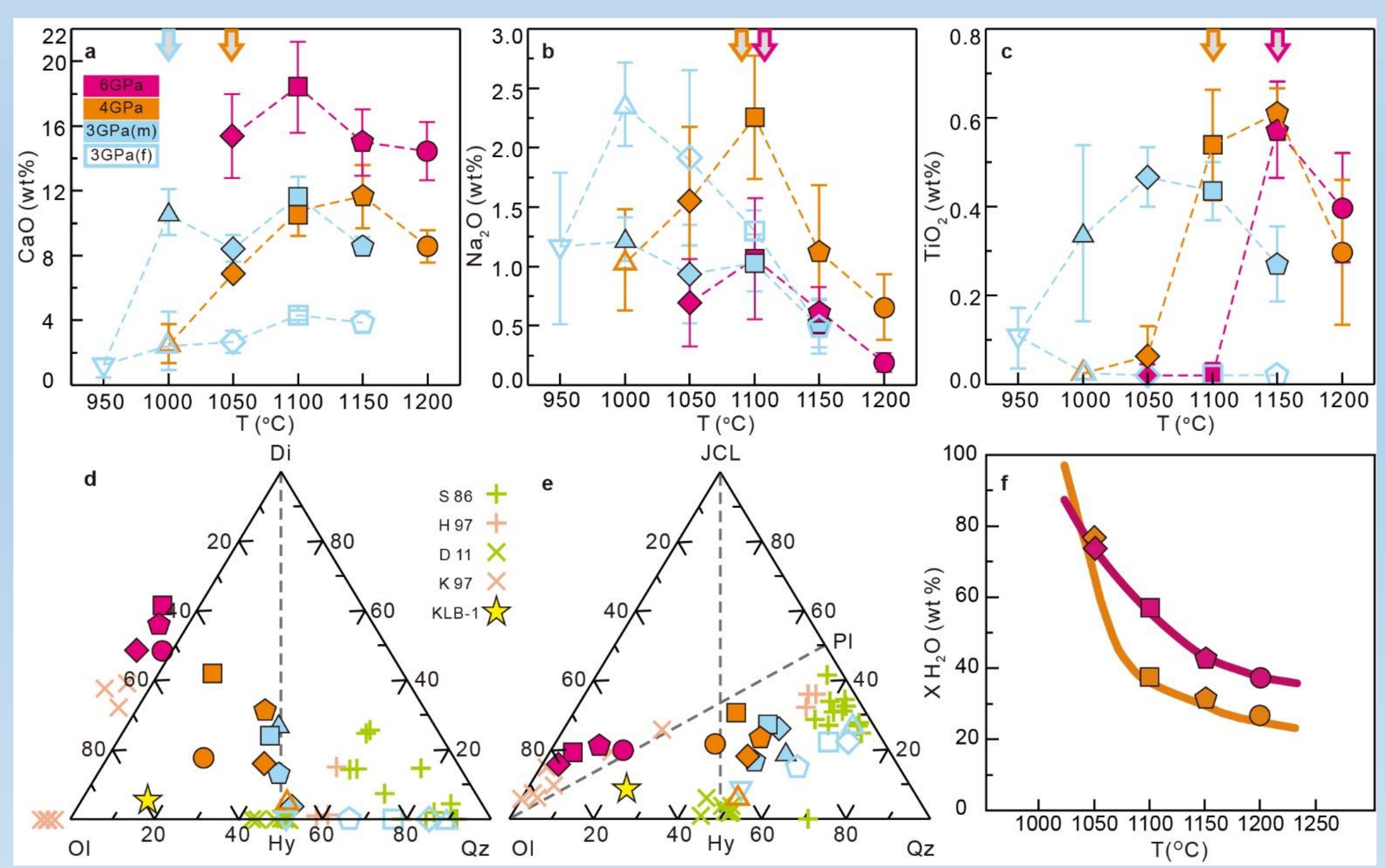
We interpreted the (sheet+spherule mixtures) as the quenched fluid above solidus; but Grove & Till (2019) interpreted the sheet and spherule as melt and fluid, respectively. At 3 GPa, coexistence of melt (felt like mass) and fluid (sheet+spherule mixtures) were found.



3 GPa < P_C, melt + fluid, the wet solidus lies between 950 and 1000 °C;

4 GPa & 6 GPa > P_C, SCF, the pseudo-solidus lies between 1000 and 1100 °C;

5. Melt and fluid Chemistry (broad area analysis by EDS)

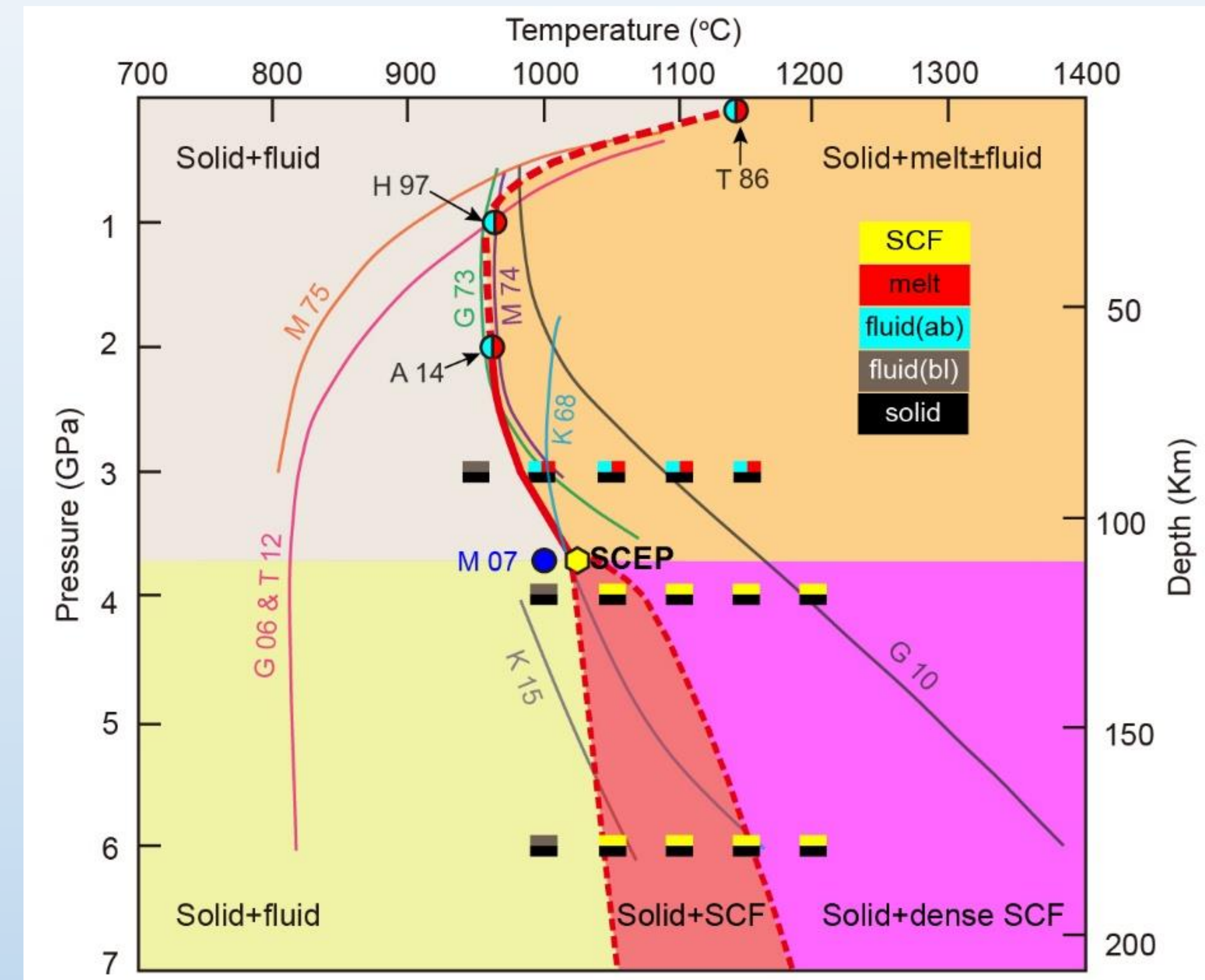


Fluid: Below solidus: **dacitic** at < 2 GPa, **hyperthene** at > 3 Gpa; Above solidus: **dacitic** to **andesitic** at 3 Gpa;

Melt/SCF: Andesitic at 1 GPa, **boninite-like** at 3 GPa, **picritic** at 4 GPa, **kimberlite-like** at > 5 Gpa;

Dilute to dense **SCF: 1050-1100 °C** at 4 GPa, **1100-1150 °C** at 6 GPa;

6. Conclusions



Wet Solidus: 950-–1000 °C at 3 GPa; SCEP: 3.8 GPa, 1025±25 °C

7. Implications

- **Magma genesis model in subduction zone;**

(Oral: V53A-03, Friday, 14:10-14:25, Moscone South – 153 – upper Mezz.)

- **Silica enrichment in sub-arc mantle;**

Fluid (below & above the solidus) is capable to cause silica enrichment

- **Formation of ultrabasic magmas in subduction zones;**

Ultramafic magmas can be formed in subduction zones at certain conditions

S86, Schneider and Eggler (1986); **H97**, Hirose (1997); **D11**, Dvir et al. (2011); **K97**, Kawamoto and Holloway (1997); **M75**, Mysen and Boettche (1975); **G06**, Grove et al. (2006); **T12**, Till et al. (2012); **G 73**, Green (1973); **G10**, Green et al. (2010); **M74**, Millhollen et al. (1974); **T86**, Takahashi (1986b); **A14**, Adam et al. (2014); **K68**, Kushiro et al. (1968); **M07**, Mibe et al. (2007); **K15**, Kessel et al. (2015);