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### 0.0.1 The solubility of Pt and Au in silicate melt at high pressure

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## Experimental design

For the sake of the repeatability and reliability of the experimental results, the uniform temperature distribution in the samples is required in the common experiments at high pressures and temperatures. However, mass transfer and redistribution at nonuniform temperature field are hot topics at recent years in geoscience academia..........[*Dan, et al.*, 2004; *Gibb and Henderson*, 2006; *Latypov*, 2003]. For studying the solubility of the Pt and Au in silicate melts at nonuniform temperature field, we look forward to obtain a maximum of temperature difference along the radial axis of the sample, and a minimum of temperature difference along the sample's axial direction. So we design an experimental apparatus to get a nonuniform temperature field (Fig. 1). In figure 1, the rake of the carbon tube is 1:5. Point A and B are higher and lower sites for temperature analysis, respectively. The changes of the eccentricity of the carbon tube, the distance from the axis of sample assembly to the center of the pyrophyllite tubes, and the flux of the cooling water can alter the value of temperature gradient of the sample in the high-pressure chamber.

**Fig. 1. The setup of sample assemblies. (**a. steel circle; b. graphite slice; c. graphite tube; d. graphite pipe; e. sample (or HBN for pressure calibration); f. Pt bag; g. pyrophyllite)

All the experiments were carried out in DS-3600 ton type apparatus. Pressure calibrate is after ....[*Akella and Kennedy*, 1971]. Temperature is monitored by $PtRh_6$-$PtRh_{30}$ thermocouple (0.15mm in diameter) with an error of $< 6$ ˚C, and its protecting tube is HBN (hexagonal borazon, 1.2mm in external diameter, 0.2mm in inside diameter and the density is $>$2.2g/cm$^3$). The temperature gradient is $< 1$˚C along the sample's axial direction in all experiments.

**Samples and results**

All the experimental samples were ground into particles with $<$63 $\mu$m in diameter, and after pressing and baking, then enclosed in the Pt bag, and put the Pt bag in the graphite pipe. The hydrous samples were assembled only just before experiments. In the experiments about the Au solubility, the Au sphere is put in the centre of the sample, and after experiment, the undissolved Au will sink to the bottom.

The sample underwent fully fused at high temperature and pressure, after quickly quenching, the experimental products are good vitreous bodies. No metal alloy has been found in thin sections of samples after magnified 80$\times$80 times. The samples were analyzed with an EDAX-1600 Superprobe. The results are list in table 1.

**Table 1. The solubility of Pt and Au in silicate melts at the nonuniform temperature field**

#: measuring point of temperature; * temperature difference between A and B

**Summary**

1. Pt can be dissolved in mafic and ultramafic melts, even the mixing of mafic and silicic melts, no matter the system is volatile bearing or volatile free.
2. Au has the same case as Pt at high pressures.
3. For trace elements Pt and Au, their solubility in silicate melts is significant for distribution of these elements at early history of the earth and mineralization, although their solubility is below 1 wt %.
4. Our results show that there is correlativity among the solubility of Pt and Au, the silicon content of melts and the temperature gradient.
5. Pt or Au bags are used to pack and protect samples at many previous experiments at intermediate, high and ultrahigh pressures. Now we know that when the sample is fused, the Pt or Au bag will be dissolved into the sample.

| Experiments | Compositions of melt | Pressure (GPa) | Temperature(˚C) | | | duration (min.) | Pt (v |
|---|---|---|---|---|---|---|---|
| | | | $T_A^{\#}$ | $T_B^{\#}$ | $\Delta T_{AB}^{*}$ | | A |
| Pt-1-2 | peridotite$_{98}$+$H_2O$ | 1.5 | 1386 | 1298 | 19 | 15 | 0.25 |
| Pt-1-4 | peridotite$_{98}$+$H_2O$ | 2.5 | 1450 | 1362 | 19 | 15 | 0.62 |
| Pt-1-5 | peridotite$_{98}$+$H_2O$ | 3.5 | 1520 | 1410 | 22 | 25 | 0.45 |
| Pt-2-1 | peridotite$_{49}$+ pyroxenite$_{50}$+$H_2O$ | 1.5 | 1520 | 1410 | 22 | 50 | 0.42 |
| Pt-2-4 | peridotite$_{49}$+ pyroxenite$_{50}$+$H_2O$ | 2.5 | 1400 | 1312 | 20 | 15 | 0.35 |
| Pt-2-3 | peridotite$_{49}$+ pyroxenite$_{50}$+$H_2O$ | 3.5 | 1580 | 1470 | 20 | 50 | 0.24 |
| Pt-3-2 | tholeiite | 1.5 | 1520 | 1405 | 23 | 50 | 0.47 |
| Pt-3-3 | tholeiite | 2.5 | 1550 | 1435 | 23 | 60 | 0.37 |
| Pt-3-4 | tholeiite | 3.5 | 1580 | 1465 | 23 | 60 | 0.34 |
| Cu-1-2 | alkali basalt$_{52}$+ granite porphyry$_{48}$ | 1.2 | 1380 | 1285 | 19 | 25 | 0.58 |
| Cu-1-3 | alkali basalt$_{52}$+ granite porphyry$_{48}$ | 2.2 | 1442 | 1354 | 19 | 25 | 0.36 |
| Cu-1-5 | alkali basalt$_{52}$+ granite porphyry$_{48}$ | 3.2 | 1500 | 1393 | 21 | 30 | 0.44 |
| Cu-2-2 | alkali basalt | 1.2 | 1390 | 1292 | 20 | 35 | 0.47 |
| Cu-2-4 | alkali basalt | 2.2 | 1448 | 1350 | 20 | 25 | 0.77 |
| Cu-2-5 | alkali basalt | 3.2 | 1523 | 1401 | 22 | 25 | 0.55 |
| | | | | | | | Au ( |
| | | | | | | | A |
| Au-35 | alkali basalt$_{98}$+$H_2O$ | 3.0 | 1565 | 1460 | 21 | 85 | 0.85 |
| Au-34 | alkali basalt$_{64}$+ diorite$_{34}$ +$H_2O$ | 2.0 | 1474 | 1458 | 3 | 75 | 0.78 |
| Au-32 | alkali basalt$_{64}$+ diorite$_{34}$ +$H_2O$ | 1.0 | 1390 | 1375 | 3 | 80 | 0.32 |

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