A comprehensive separation procedure for precise determination of Re, Ir, Ru, Pt and Pd in geological samples

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It is difficult to precisely determine Re, Ir, Ru, Pt and Pd in geological samples due to the low abundance of these elements. Moreover, the potential polyatomic interferences on Ru, ZrO interferences on Pd, and HfO interferences on Ir and Pt, make precise determination of these elements more challenging. In this study, we have developed a comprehensive method for separation of Re, Ir, Ru, Pt and Pd in geological samples based on anion exchange method, in order to realize reliable isotope dilution (ID) analyses of these elements.

The Re, Ir, Ru, Pt and Pd are firstly group-separated in Re-Ru, Ir-Pt and Pd by using 2 mL Biorad AG 1 X 8 (100-200 mesh) anion exchange columns. Subsequently, the Re-Ru is further purified using 0.25 mL Biorad AG1 X 8 (100-200 mesh) anion exchange columns. The Ru can also be further purified via a microdistillation method by using 50 μL of CrO_3-H_2SO_4 solution as an oxidant. The Ir-Pt and Pd are further purified using Eichrom-LN columns to completely remove potential HfO and ZrO interferences, respectively.

After this comprehensive separation procedure, the Re, Ru, Ir, Pt and Pd can be precisely measured by ID-MC-ICP-MS. The Ru further purified by microdistillation method can also be measured by ID-NTIMS method.

Finally, the USGS reference materials BHVO-2, BCR-2, BIR-1a and DNC-1 are measured and the analytical results of Re, Ir, Ru, Pt and Pd are in good agreement with the published values.

Thermodynamic potentials of Au-Hg binary solid solution

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Standard thermodynamic functions ($\Delta_f G^0$, S^0) of $Au_{1-x}Hg_x$ ($0 \le x_{Hg} \le 0.2$) solid solution have been calculated using the formalism of Redlich-Kister method [1]:

$$G^{ex} = x_1 x_2 ({}^0L + {}^1L (x_1 - x_2)) \quad (1)$$

Parameters of equation (1) were obtained by regression analysis of the data [2]:

$${}^0L \text{ (J/mol)} = 1500 + 4.05T$$

$${}^1L \text{ (J/mol)} = -7499.99 + 2.15T.$$

The excess entropy of solid solution was evaluated from equation [3]:

$$S^{ex} = -\left(\frac{\partial G^{ex}}{\partial T}\right)_P$$

Excess thermodynamic functions were used to calculate the standard thermodynamic properties of Hg solid solution in (Au) with mercury content 1-20 at. % (Table 1).

Solid solutions	$\Delta_f G^0$, J /mol	S^0, J/(mol•K)
Au0.99Hg0.01	-179	48.177
Au0.98Hg0.02	-319	48.752
Au0.96Hg0.04	-555	49.79
Au0.94Hg0.06	-750	50.745
Au0.92Hg0.08	-916	51.648
Au0.9Hg0.1	-1056	52.513
Au0.88Hg0.12	-1174	53.348
Au0.86Hg0.14	-1272	54.159
Au0.84Hg0.16	-1353	54.949
Au0.82Hg0.18	-1417	55.721
Au0.8Hg0.2	-1466	56.477

Table 1: Standard thermodynamic properties of Au-Hg solid solution

The obtained data can be used in different software packages for developing physicochemical models in natural and technological processes with participation of gold and mercury.

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[1] Hillert (2008) Phase equilibria, phase diagrams and phase transformations, Cambridge. [2] Okamoto & Massalski (1989) *Bulletin of Alloy Phase Diagrams* **10,** 50-58. [3] Anderson (2005) Thermodynamics of natural systems, Cambridge.

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