

Au and PT behaviour in natural processes: implications in the Bushveld Complex and Witwatersrand

STENINA, N.G. Institute of geology SB RAS, Novosibirsk, Russia

Platinum and gold occupy the neighbouring cells in the Mendeleev Table and differ in only one electron in their electron shell ($5d^96s^1$ and $5d^{10}6s^1$ correspondingly). They are originated from the parent basic magma and have similar chemical behaviour. Nevertheless these elements are strongly distinguished as it concerns the formation of their deposits. Platinum forms industrial deposits mainly in the magmatic complexes, while gold goes away, forming the large deposits of hydrothermal character.

Such behaviour of Pt and Au was explained in terms of mineral matter transformation and redeposition via the aquacomplex-intermediate of $[2SiO_3 - OH_2 - 2M^{n+}M^{m+}O_4]^-$ type. Aquacomplex has an unified energy structure caused by interactions of the electrons of the constituent elements. Due to this Au gives its $6s^1$ electron to Fe ($3d^64s^2$), which is the best gold partner within the specific $[2SiO_3-OH_2-2(Au,M^{n+})(Fe,M^{m+})O_4]^-$ aquacomplex. Through these intermediates gold together with iron migrate in the course of rock matter metamorphism until the mineral continuum falls on the conditions of the (Au-Fe) aquacomplex disintegration. This occurs at the point of OX/Red inversion in the mineral system or when the front of metamorphizing matter reaches the Ca (Sr, Ba) containing rocks. As the aquacomplexes are disintegrated, quartz and ore mineralization occurs; native gold and free water are liberated. In platinum, because of one electron lack at the d level, the inner ionic bond between $6s^1$ electron and $5d^9$ positive charged vacancy is formed. This prevents iron from borrowing $6s^1$ electron of platinum and further joint moving throw mineral matter. Therefore, platinum is mineralized «in situ», within the layered intrusions.

This mechanism is evidenced by the close association and geological peculiarities of the world class platinum and gold deposits of the Bushveld Complex and Witwatersrand.