渗流热卤水成矿作用的意义与矿床成因标志（摘要）[1]

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本文在综合整理研究各种天然水化学成分资料的基础上指出，一些重要的现代含矿溶液（如红海、索尔顿海、密西西比中部、切列肯等处）与岩浆水在成分上明显不同，其SO_4^{2-}/Cl^-与HCO_3^-/Cl^-值均<0.01，可称为高纯氯化物卤水。据产于火山口或火山锥上的一些火山热泉资料分析判断，其中不存在高纯氯化物水。在我们所知的一些火山射气分析资料中亦不存在持续的高纯氯质射气。雷德尔汇集的火成岩中气液包裹体成分资料也是如此。因而可以认为，高纯氯化物卤水极少可能与岩浆有关。鉴于高纯氯化物卤水溶解重金属的能力极强，它们在渗流过程中完全有可能从围岩中溶滤和聚集重金属，从而形成一种与岩浆演化无关的含矿溶液。这种溶液在地下或地表水体底部成矿就是渗流热卤水成矿作用。

作者认为至今广为流行的那些缺乏火山物质的“远源火山沉积矿床”和独立于与侵入体有关的蚀变和矿化分带晕圈之外的“远成低温热液矿床”在理论上是难以解释的，实际上它们大多数很可能就是各种形式的渗流热卤水矿床。

从中国主要铁和有色金属矿床的实际材料来看，在与侵入体有成因联系的主要铁和有色金属矿床中以及沉积成因的铁、铝等矿床中均无重晶石的重要富集。除近源火山矿床和某些稀有稀土矿床外，重晶石的聚集是渗流热卤水作用的产物，可以作为该类矿床的一个成因标志。

根据中国硅质岩的发育与金属矿床的关系来看，一些非生物成因并与火山作用无紧密联系的硅质岩可能是渗流热卤水成因的，可以作为该类矿床的成因标志。

根据中国130处铁和有色金属内生矿化区3000余件硫同位素数据，以及国外100余个铜和铜镍矿床的统计资料看，硫化物的硫同位素组成可作为判别渗流热卤水成矿的另一标志。在一定条件下它可以帮助排除岩浆来源硫存在的可能性，或者帮助排除正常沉积成矿的可能性，以确定矿床成因。

渗流热卤水成因的矿床，其矿化特点介于典型的内生矿床和典型的外生矿床之间，亦此亦彼，非此非彼。这点可作为判别渗流热卤水矿床的参考标志。

根据上述标志估计，渗流热卤水成因的矿床至少占中国汞、锑和锰矿的大多数，铅、锌矿储量的多数，铁矿石储量的很重要一部分，以及铜矿、钼矿和钨矿储量的少部分。

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THE ROLE OF HOT VADOSE BRINE IN MINERALIZATION AND THE GENETIC INDICATORS OF THE ORE DEPOSITS

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Abstract

Based on the sorting out and comprehensive study of the data available about the chemical composition of various natural water, the authords hold that some of the important modern ore-bearing solutions occurring in Red Sea, Salton Sea, the middle portion of Mississipi State and Cheleken etc.can be called highly pure chloride brine in that their values of SO_4^{2-}/Cl^- and HCO_3^-/Cl^- are <0.01, and their composition is appreciably distinct from that of magmatic water. The chemical analytical data of some volcanic hot springs in volcanic cones or craters show that there exists no highly pure chloride brine there at all. Some analytical data of volcanic emanating gas known to us also indicate that highly pure chloric emanation does not develop continuously either. And the same phenomena can be observed in the data of gas-liquid inclusions in minerals of igneous rocks collected by Roedder.This made us believe that there is little possibility of the highly pure chloride brine relating to magma. In view of the intense solubility of the heavy metals in the highly pure chloride brine, it is conceivable that this brine would possibly extract these metals from wall rocks and accumulate them during its permeation, forming a sort of ore-bearing solution which has nothing to do with the magmatic evolution. Ore deposition in this solution beneath the surface or at the bottom of the surface water is called mineralization of hot vadose brine.

In fact, it is very difficult to make a satisfactory explanation about the two rather prevalent theories "volcanic sedimentary deposits with distant sources" which are deficient in volcanic material and "telethemal ore deposits" which are independent of the alteration and mineralization halo related to intrusive mass. The authors consider that most of these deposits are likely to be hot vadose brine deposits of various types.

Abundant data reveal that there is not any noticeable concentration of barite both in the major deposits of iron or nonferrous metals genetically related to intrusive bodies and in the sedimentary deposits of iron and aluminium. Except for volcanic deposits with close sources and some rare or rere-earth deposits, the accumulation of barite is the result of the action of hot vadose brine and may be regarded as one of the genetic indicators of the deposits of the hot vadose brine type.

The relation beween the develoment of silicolites and metallic ore deposits in China shows that some silicolites which are of nonbiological genesis and are not closely related to volcanism might be the products of hot vadose brine so that they also serve as indicators for deposits of hot vadose brine type.

From more than 3000 sulfuric isotopic data of 130 localities of endogenic iron and nonferrous mineralization in China and the data of over 100 foreign copper and copper-nickel deposits, the authors are under the impression that the sulfuric isotopic composition of sulfide might act as another discriminating mark for the mineralization of hot vadose brine. Under certain conditions, this indicator is of some help in ruling out the possibility of the existence of magmatic origin sulfur or the possibility of the normal sedimentary mineralization, thus facilitating the identification of ore genesis.

The deposits of hot vadose brine type bear the characteristics of mineralization between typical endogenic deposits and typical exogenic deposits. This may be taken as an additional indicator for deposits of this sort.

According to above described indicators, the deposits formed by hot vadose brine are estimated to make up the great majority of the reserves of the mercury, antimony and manganese ore in China, the majority of the reserves of the lead and zinc ore, a considerable portion of the reserves of the iron ore and a minor portion of the reserves of the copper, molybdenum and tungsten ore.