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再论花岗岩按照Sr-Yb的分类: 标志

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摘要：

2006年作者曾经按照$Sr=400\times10^{-6}$和$Yb=2\times10^{-6}$作为标志将花岗岩分为埃达克岩、喜马拉雅型花岗岩、浙闽型花岗岩和广西型花岗岩,在浙闽型中又分出南岭型($Sr<100\times10^{-6}$和$Yb>2\times10^{-6}$),于是花岗岩被分为5类。$Sr=400\times10^{-6}$和$Yb=2\times10^{-6}$是根据阿留申群岛中的Adak岛的资料得出来的。本文统计了全球花岗岩6000多个数据(其中,埃达克型花岗岩为2810个,喜马拉雅型花岗岩636个,浙闽型花岗岩1183个,南岭型花岗岩1518个,广西型花岗岩142个,总共6289个),统计的结果,各类花岗岩的地球化学特征大致如下: (1)埃达克型花岗岩富Al_2O_3 和Sr,贫Y和Yb,具较高和变化的铕异常,绝大多数样品的$Sr>300\times10^{-6}$,$Yb<2.5\times10^{-6}$(当$Sr=400\times10^{-6}\sim600\times10^{-6}$ 时Yb值最大,Sr超过600×10^{-6},Yb降低至$<2\times10^{-6}$),Al_2O_3 在14%~18%之间,Eu/Eu^*大多在0.6~1.2范围; (2)喜马拉雅型花岗岩贫Sr和Yb,具中等的Al_2O_3 和变化的Eu/Eu^*,$Sr<300\times10^{-6}$和$Yb<2\times10^{-6}$(少数$Sr>300\times10^{-6}$),Al_2O_3 为13%~17%,Eu/Eu^*为0.2~1.0; (3)浙闽型花岗岩贫Sr富Yb,Sr在$40\times10^{-6}\sim400\times10^{-6}$之间,$Yb>1.5\times10^{-6}$,$Al_2O_3$ 和Eu/Eu^*的变化类似喜马拉雅型花岗岩,Al_2O_3 为12%~17%,Eu/Eu^*为0.4~1.0; (4)南岭型花岗岩以很低的Sr、Al_2O_3 和Eu/Eu^*以及很高的Yb而不同于上述各类花岗岩,通常$Yb>1.5\times10^{-6}$,$Sr<100\times10^{-6}$(Yb变化大,绝大多数$>2\times10^{-6}$; 当Yb在$2\times10^{-6}\sim8\times10^{-6}$时,部分样品Sr可$>100\times10^{-6}$,但很少$>200\times10^{-6}$); Al_2O_3 <14%,集中在11%~13%之间,Eu/Eu^* <0.7,大多<0.4; Yb越大,Sr越低,负铕异常越明显。文中讨论了花岗岩Sr-Yb分类的意义,指出本分类适用于产于大陆和海洋的绝大多数中酸性岩浆岩(可能不适用于一部分特别富铁和钾的花岗岩,如具有高Sr和Yb特征的广西型花岗岩)。不同类型的花岗岩主要反映了源区压力的不同,而源区成分、温度、部分熔融程度、水和挥发分的加入以及岩浆混合等的影响可能是次要的。文中指出,该分类的依据、其实质,是熔体与残留相平衡的理论。与浙闽型花岗岩平衡的残留相是斜长石,与喜马拉雅型花岗岩平衡的是斜长石＋石榴石,与埃达克型花岗岩平衡的是石榴石,与南岭型花岗岩平衡的是富钙的斜长石。文中指出,加强实验岩石学研究,将年代学和地球化学研究密切结合起来是深化花岗岩研究的关键。

英文摘要：

In our previous study, based on the values of $Sr=400\times10^{-6}$ and $Yb=2\times10^{-6}$ the granites are divided into five types; i.e., Adakite, Himalaya-type, Zhemin-type, Guangxi-type and Nanling-type granites($Sr<100\times10^{-6}$ and $Yb>2\times10^{-6}$) separated from Zhemin-type (Zhang *et al.*, 2006a). The values of $Sr=400\times10^{-6}$ and $Yb=2\times10^{-6}$ were originally defined according to the data of Adak Island in Aleutian Islands. In this study, A total of 6289 granite data (Adak-type granite: 2810; Himalaya-type: 636; Zhemin-type: 1183; Nanling-type: 1518; Guangxi-type: 142) are collected and the geochemical characteristics for each of the types are summarized as follows. (1) Adak-type granite is rich in Al_2O_3 and Sr and poor in Y and Yb with relatively high and variable Eu anomaly. Most samples have $Sr>300\times10^{-6}$,$Yb<2.5\times10^{-6}$(Yb is higher than 2×10^{-6} when $Sr=400\times10^{-6}\sim600\times10^{-6}$ and lower than 2×10^{-6} when $Sr>600\times10^{-6}$),Al_2O_3 14%~18% and Eu/Eu^* 0.6~1.2; (2) Himalaya-type granite is poor in Sr and Yb with medium Al_2O_3 and variable Eu/Eu^*. $Sr<300\times10^{-6}$, $Yb<2\times10^{-6}$(a few samples having $Sr>300\times10^{-6}$),Al_2O_3 13%~17% and Eu/Eu^* 0.2~1.0; (3) Zhemin-type granite is rich in Yb and poor in Sr with Sr between 40×10^{-6} and 400×10^{-6} and $Yb>1.5\times10^{-6}$. Al_2O_3 and Eu/Eu^* are similar to that of Himalaya-type: Al_2O_3 12%~17% and Eu/Eu^* 0.4~1.0; (4) Nanling-type granite is different from the former three with quite low Sr, Al_2O_3 and Eu/Eu^* and fairly high Yb. Generally, $Yb>1.5\times10^{-6}$,$Sr<100\times10^{-6}$, Al_2O_3 <14% (mostly between 11~13 %), and $Eu/Eu^*<0.7$ (often under 0.4). The content of Yb is literally variable and mostly above 2×10^{-6}. With Yb between 2×10^{-6} and 8×10^{-6}, Sr content in some samples is above 100×10^{-6}, but rarely above 200×10^{-6}. This type is characterized by higher Yb content corresponds to lower Sr and very negative Eu anomaly. This paper discussed the siginificance of Sr-Yb classification of granitic rocks and proposed that the classification is suitable for most medium-acidic magmatic rocks forming in continents and oceans, but may not suitable for the granites with very high Fe and K such as Guangxi-type granite. The classification suggests that the variation in the formation pressure of the source rather than the influence of the source composition, temperature, degree of partial melting, water and volatile, and magma mixing. The classification is actually based on the theory of equilibrium between melt and residue phase. The residual phase is plagioclase for the Zhemin-type granite; plagioclase and garnet for the Himalaya-type granite; garnet for the adak-type granite and calcium-rich plagioclase for the Nanling-type granite. It is suggested that t he key to deepen the research of granite is to strengthen experimental petrology and combine closely geochronology with geochemistry.

关键词：花岗岩 分类 以Sr-Yb为指标 埃达克型花岗岩 喜马拉雅型花岗岩 浙闽型花岗岩 南岭型花岗岩 压力

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