The isotopic evidence of gas source of the cold mineral springs with high pCO_2 in Wudalianchi

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Active volcanoes are often associated with thermal springs, but some cold mineral springs exist near the active volcanoes in Wudalianchi, Heilongjiang Province, China, and these cold spas are rich in CO_2. Water analysis shows that these HCO_3^- type mineral springs have higher mineralization degree (>1000 mg/L) and are rich in CO_2, Fe^{2+}(>20 mg/L), Sr(>1 mg/L), dissolved Si (>20 mg/L) with lower temperature(<10℃= and pH<6.5. Dissolved and evolved gases of all these spas have the same composition, and are composed mainly of CO_2 with minor N_2 and O_2. The $\delta^{13}C$ and $\delta^{18}O$ of dissolved and evolved CO_2 in these spas are almost identical, and all $\delta^{13}C$ values are between -2– -9, so consistent with the $\delta^{13}C$ of the inclusions in basalt of upper mantle (-4– -8). We presume that the CO_2 of mineral springs derives from magma chamber of the upper mantle and comes through magma channels and faults in the Wudalianchi active volcanic area. While ^4He content exceeds 5000×10^{-6} cm^3 STP/L in evolved gas of these spas, and $^3He/^4He$ ratios in the dissolved and evolved gases vary between 2.6–3.8 Ra (where Ra is the atmosphere ratio of $^3He/^4He=1.4\times10^{-6}$), respectively. Higher contents of ^4He in these spas enable us to make it sure that the gas of these mineral springs mainly derives from magma chamber of the upper mantle, and the ratio of $^3He/^4He$ lends further evidence. Because the ratio of $^3He/^4He$ of upper mantle is 8.4 Ra, one third of He in these spas attributes to the upper mantle based on simple mixing at least.

Key words $\delta^{13}C$; $\delta^{18}O$; $^3He/^4He$; high PCO_2; cold mineral spring

The acid neutralizing capacity (ANC) of South Africa's freshwater ecosystems

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Acidification is considered the most important one of the primary chemical stress factors that impact on freshwater ecosystems. In unpolluted freshwater systems, the primary controls on the degree of acidification are factors such as the geological substrate of the catchment area, the presence of organic acids secreted by vegetation in the river system, and equilibrium exchange of carbon dioxide with the atmosphere. Anthropogenic factors that can impact on the degree of acidification of freshwater systems include agricultural, mining and industrial activities, either through direct runoff into river systems or through deposition of atmospheric pollutants from these sources. The capacity factors alkalinity and acidity, which represent the acid- and base-neutralizing capacity (ANC and BCN) of an aqueous system, have been used as more reliable measures of the acidic character of freshwater systems than pH. Unlike pH, ANC and BNC are not affected by parameters such as temperature and pressure. Therefore, ANC has been employed as a predictor of biological status in critical load assessments. Freshwater systems with ANC's eq/L isμeq/L are considered sensitive to acidification, ANC=0 μbelow 150 commonly used as the predictor for fish species such as trout in lakes, and an eq/L as more realistic for streams. Acid-neutralizing capacity μANC value of 40 (ANC) can be determined by titration with a strong acid to a preselected equivalence point. Alternatively, it can be calculated as the difference between base cations ([BC]) and strong acid anions ([SAA]): ANC=[BC]-[SAA]=$[Ca^{2+}]+[Mg^{2+}]+[Na^+]+[K^+]-[SO_4^{2-}]-[NO_3^-]-[Cl^-]$ To date, there has been no attempt to establish the ANC of South Africa's freshwater ecosystems or variability therein, despite the fact that long-term water quality monitoring data exist for all the parameters needed to calculate it according to the above equations. As a result, the relationship between the acid neutralizing capacity of freshwater ecosystems in South Africa and biodiversity factors, such as fish status, is unknown. Results of the first comprehensive (country-wide scale) evaluation of the acid neutralizing capacity of river systems in South Africa will be presented. Long-term monitoring data obtained from the Department of Water Affairs and Forestry (DWAF) from most of South Africa's river systems were used to establish geographic and temporal variabilities in ANC. The results show that the Berg and Breede River systems are most susceptible to acidification, and that geological substrate appears to explain most of the geographic variabilities observed. However, there are indications that the Olifants River in the Mpumalanga Province has lower ANC values than expected from the carbonate-containing lithologies in its catchment. It is proposed that this is related to pollution and acidification originating from coal-fired power stations in its catchment areas.

Key words acid neutralizing capacity; freshwater; river; ecosystem