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He and N isotopes in thermal springs of the Mexican Pacific coast: subducting slab, continental crust and mantle contributions to fluids of a forearc zone.

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Two oceanic plates are subducting beneath the continent along the Mexican Pacific coast: Cocos Plate south of Colima graben (∼19°N) and a young Rivera Plate to the north of Colima graben. The trench is situated ∼ 70 km from the shore line which is very close comparing with other continental margins. There are 26 groups of thermal springs between 16°N and 21°N, in a 30 km-wide zone along the coast. The temperature and salinity ranges are 40-90°C and 100-20,000 ppm, respectively. The springs are mainly of a low salinity (< 1000 ppm), high pH (8-10) and temperatures of 37-50°C. Almost all springs discharge bubbling gas with N2 as a predominant component and have He content between 400 and 1500 ppmV. Two groups of springs are methane-rich (70 and 10 vol%). The CO2-rich springs and high-HCO3 waters are absent.
All springs to the south of the Michoacan-Guerrero boarder (∼ 18°N) are characterized by N2/Ar ≈ 100, 15N ≈0 and 3He/4He ratios lower than 0.2Ra (where Ra=1.4x10-6, the air ratio) except the Paso Real springs (0.9Ra) located within a Coyuca seismogenic fracture zone. Springs along the Michoacan coast, the northern part of the Cocos Plate subduction, discharge gases with 1.5Ra < 3He/4He <2.5Ra but still low, close to the atmospheric N2/Ar and 15N ≈0. All springs located within the Colima graben have high 3He/4He (up to 4.5Ra) and elevated N2/Ar and 15N. The El Salitre (La Tuna) springs located within the southern board of the Colima graben discharge saline Na-Ca-Cl water (46°C, Cl=15,000 ppm) with N2/Ar > 400, 15N = +4.6%■, almost no CH4 (<0.1 %) and 3He/4He = 2.3Ra. The only group of hot springs within the Jalisco Block and close to the shore line, Rio Purificacion, discharge hot, saline Na-Cl water (80°C, 12,000 ppm of Cl), with N2/Ar > 300, 15N = +5%■ and 3He/4He = 0.4Ra. A number of hot and warm springs associated with Puerto Vallarta graben are characterized by high 3He/4He up to 4.5Ra, elevated N2/Ar and 15N. The last group, Punta Mita hot springs (20° 46'N), are submarine vents, 10 m deep. Their gas has elevated CH4 content, high N2/Ar and 3He/4He = 0.4Ra.
The results are discussed in several aspects: (1) Why this low heat flow zone is characterized by so high hydrothermal activity? (2) Does the elevated 3He/4He within Michoacan-Colima profile relate to the slab detachment associated with the contact between Cocos and Rivera plates? (3) Do high N2/Ar and 15N above the Rivera Plate subduction indicate the forearc degassing of the accreted organic-rich oceanic sediments? (4) How to estimate the total flux of volatiles released in a forearc zone from the subducting slab?