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First geochemical survey of fumarolic gases from Lascar volcano (Central Andes, Chile)

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Lascar is a composite, medium- to high-K calc-alkaline stratovolcano (altitude 5,592 m) located in the Central Andean Volcanic Zone (CAVZ, Northern Chile), on the eastern fringe of the Salar de Atacama basin that is one of the driest deserts in the world. Lascar volcano, whose evolution started at 43 Ka, is characterized by relatively frequent vulcanian and plinian eruptions, and considered the most active volcano of this part of Central Andes. Since 1984, Lascar has undergone several cycles of lava dome growth and collapse with sporadic vulcanian eruptions (1986, 1990, 1992), culminated on 19 April 1993 when its largest historical eruption, generating a column of about 23 km, took place. Presently, the Lascar volcano summit hosts six nested NE-SE trending craters. The internal flanks and the bottom of the currently active crater (800 m in diameter and more than 400 m deep) are characterized by the presence of a huge number of fumarolic discharges that gives rise to a persistent SO_2-rich plume. In November 2002, in the framework of a joint collaboration between the University Catolica del Norte of Atacama (Chile) and the University of Florence (Italy), the first sampling of crater fumaroles ever performed at Lascar volcano was carried out. Gas sampling was repeated in October 2005 and October 2006 to obtain a dataset able to reliably represent the extended fumarolic field of Lascar volcano active crater. In the present work, the chemical and the isotopic compositions of the fumarolic gases collected during these three sampling campaigns, whose measured outlet temperatures range from 30 to 385 ˚C, are presented and discussed. The main geochemical

features of the fumaroles from Lascar volcano can be summarized, as follows: 1) variable H_2O/CO_2 ratio, which strongly decreases as the outlet temperature of the gas vents increases; 2) high concentrations of both acidic gases (HF, HCl and SO_2) and temperature-dependent gas compounds (H_2 and CO), even at low fumarolic outlet temperatures; 3) relatively low values of the H_2S/SO_2 ratio; 4) magmatic signature for Carbon (in CO_2) and Helium isotopes; 5) high C_2-C_3 alkenes/alkanes ratios; 6) no significant contribution of organic gas compounds commonly originated at relatively low temperature (i.e. C_{4+} hydrocarbons). All this evidences consistently suggest the virtual absence of any hydrothermal system, especially in the inner zone of the fumarolic field corresponding to the central part of the active crater. On this basis, magmatic-related fluids, only slightly affected by air contamination, seem to represent by far the main source of the fumarolic vents at Lascar volcano.