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Fingerprints of endogenous process on Europa through linear spectral modeling of ground-based observations (ESO/VLT/SINFONI)

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Jupiter's moon Europa harbors a very young surface dated, based on cratering rates, to 10-50 M.y (Zahnle et al. 1998, Pappalardo et al. 1999). This young age implies rapid surface recycling and reprocessing, partially engendered by a global salty subsurface liquid ocean that could result in tectonic activity (Schmidt et al. 2011, Kattenhorn et al. 2014) and active plumes (Roth et al. 2014). The surface of Europa should contain important clues about the composition of this sub-surface briny ocean and about the potential presence of material of exobiological interest in it, thus reinforcing Europa as a major target of interest for upcoming space missions such as the ESA L-class mission JUICE.

To perform the investigation of the composition of the surface of Europa, a global mapping campaign of the satellite was performed between October 2011 and January 2012 with the integral field spectrograph SINFONI on the Very Large Telescope (VLT) in Chile. The high spectral binning of this instrument (0.5 nm) is suitable to detect any narrow mineral signature in the wavelength range 1.45-2.45 μm. The spatially resolved spectra we obtained over five epochs nearly cover the entire surface of Europa with a pixel scale of 12.5 by 25 m.a.s ($\sim$35 by 70 km on Europa's surface), thus permitting a global scale study.

Until recently, a large majority of studies only proposed sulfate salts along with sulfuric acid hydrate and water-ice to be present on Europa's surface. However, recent works based on Europa's surface coloration in the visible wavelength range and NIR spectral analysis support the hypothesis of the predominance of chlorine salts instead of sulfate salts (Hand & Carlson 2015, Fischer et al. 2015). Our linear spectral modeling supports this new hypothesis insofar as the use of Mg-bearing chlorines improved the fits whatever the region. As expected, the distribution of sulfuric acid hydrate is correlated to the Iogenic sulfur ion implantation flux distribution (Hendrix et al. 2011, Dalton et al. 2013). However, the distribution of chlorine species is inconsistent with this process and together with abundance maps of different sizes of crystalline water-ice grain exhibits clear spatial inhomogeneities in their distribution, hence suggesting an endogenous origin for these species. Abundance maps will be presented and the question of the distribution and the formation of these species will be addressed.