Probing the TransNeptunian region with JWST/NIRSpec

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The region beyond Neptune holds a population of icy objects, diverse in both dynamical and physical properties (composition, colors, size, multiplicity…). They are remnants of the planet formation process, preserving a record of the dynamical dispersal of the protoplanetary disk, and of the conditions prevailing in the early phases of the solar system. In comparison to planets, these TransNeptunian Objects (TNOs) have undergone much less alteration, though most bodies did suffer from numerous collisional events, as well as some thermal and dynamical processing.

Since the discovery of the first TNO in 1992, a sustained observational effort has revealed a complex picture, which we cannot fully interpret yet, for lack of critical data. For instance, of the ~4000 known TNOs, surface colors are known for ~20% of the population, sizes and albedos for 100-150 objects, and useful near-infrared spectra for ~50 objects. In this context, JWST/NIRSpec will provide data far superior in SNR to what has been achieved after 30 years of observations. Besides, NIRSpec will access the 3-5μm wavelength range, where fundamental absorption bands of C-H-, N-H- and O-H-bearing ices can be found, thus providing TNO surface compositions with an accuracy never achieved before.

A number of GTO programs are scheduled to observe TNOs. GTO program 1231 will study two Charon-like objects, to assess whether their surface might show evidence for past cryovolcanism. Similarly to volcanism on Earth which plays an important role in reshaping the surface of our planet, cryovolcanism is the process by which liquid water and other volatiles are brought to the surface of icy bodies. Because it is a clear marker of geological activity, objects showing evidence of cryovolcanism (e.g., Titan, Europa or Enceladus) are the subject of intense investigation.

The objective of this JWST/NIRSpec program is to constrain the presence of minor species which could be seen as indicative of possible past cryovolcanism (including but not restricted to ammonia, pure and hydrates, and methanol) on a few well-chosen targets among mid-sized TNOs. In conjunction with the other GTO programs and a GO Large Program, we will constrain the occurrence of differentiation and cryovolcanism on the TNO population as a whole, as well as other evolutionary processes (i.e., irradiation, collisions). Eventually, GTO data will start to reveal the inventory of material in the outer solar system (icy volatiles, complex organics…), which in time will provide clues to the origin of TNOs, and to processes that shaped then for 4.5 Gyr.