ICES ON TNOS: THE CASE OF RR TAXONOMIC CLASS. M. A. Barucci¹ F. Merlin¹, S. Fornasier¹, C. de Bergh¹, D. Perna¹, LESIA-Observatoire de Paris, CNRS, Univ. Pierre et Marie Curie, Univ. Paris Diderot, 92195 Meudon Principal Cedex, France (antonella.barucci@obspm.fr).

Introduction: The last 20 years of studies of transneptunian objects changed completely our view on the formation and evolution of the Solar System. Nevertheless their physical properties remain still unexplained. Barucci et al. [1] completed a second large observational program to characterize the physical properties and the surface composition of these objects, obtaining high quality data for about 40 objects using the most powerful telescopes and instruments at VLT-ESO. A statistical analysis of all existing data including those available in the literature, covering the visible and near-infrared spectral range, was carried out studying all the possible relations between spectral characteristics and other physical and dynamical parameters. The data for 75 objects were collected including two TNOs’ satellites (Charon and Hi’iaka) [1].

To investigate the presence of ice on the surfaces, these objects have been divided into three groups depending on their ice content. The first group includes objects with sure detection of ices (band deep >3% at >3σ level), the second concerns tentative detections as the objects do not follow the strictly defined statistical criteria, while the last group contains objects for which the measured depth is smaller than 3%. The distribution of ices has been analyzed as a function of the object absolute magnitude, taxonomy [2] and dynamical classes. The main results are: i) all objects belonging to the BB class have icy surfaces, while none of the objects of the IR class shows “sure” water ice detection; ii) the possible presence of methanol has been detected on very red objects (following the RR class). The distribution of ice content vs. dynamical parameters (semimajor axis, inclination and eccentricity) is almost random, except in the Centaur population, where no high ice content is present on the surface. These results together with the fact that all colors are also randomly distributed, strongly argue in favor of the important mixing that occurred during the solar system formation [3, 4].

Later on, Brown et al [5], looking at the color diversity on the transneptunian population, proposed a chemical and dynamical plausible hypothesis where the surface composition and colours are set by formation-location-dependent volatile loss in the early solar system. They concluded that objects formed further in the disk retain methanol.

Analysis of RR class objects: In this work we concentrate our analysis on the reddest objects of the transneptunian and centaur populations. The RR class of objects contains more than ¼ of the whole populations and contains objects with all three classes of ice content (sure, no ices and tentative ice detection) with a slight majority of sure ice content. The dynamical classes include Centaurs, detached, classical, plutinos and scattered objects.

We obtained new observations of the extra red plutino (55638) 2002 VE95 [6]. It shows a clear heterogeneity on its surface covered by different ice compounds, such as water ice (4-19%) and methanol (10-12%) and different organic compounds. This object is among the reddest ones with spectral characteristics very similar to (5145) Pholus [7] and (90377) Sedna [8]. These three very red objects belong to completely different dynamical classes, but have a similar composition, even if Sedna has a more significant variation on the surface with hydrocarbon ice which, in some cases, fits better with small traces of methane and nitrogen. The dimensions of the three objects seem also different: about 150km for Pholus, 250km for 2002 VE95 and higher than 1000km for Sedna.

Conclusions: Methanol has been detected mainly on very red objects of the RR taxonomical class. This could imply that these objects exhibit an almost primordial surface. This is in agreement with laboratory irradiation experiments [9] showing a strong reddening of the spectra composed of methanol. The effect of reddening depends on the composition of the object and on the irradiation history while the thickness of the organic crust depends on the irradiation dose. These results are in agreement with the hypothesis that a substantial mixing has occurred after the transneptunian objects formation but cannot exclude the hypothesis of initial heterogeneity.

References: