Composition of 298 Baptistina: Implications for K-T Impactor Link. V. Reddy[1], M. S. Kelley[2], J. P. Emery[3], M. J. Gaffey[4], W. F. Bottke[5], D. Nesvorny[5], M. Schaal[6], A. Cramer[7], and D. Takir[4], [1]Dept. of ESSP, University of North Dakota (UND), Grand Forks, ND. Vishnu.kanupuru@und.nodak.edu, [2]NASA Headquarters, Washington, D.C., [3]SETI Institute, Mountain View, CA, [4]Dept. of Space Studies, UND, [5]Dept. of Space Studies, Southwest Research Institute, Boulder, CO, [6]Dept. of Physics, UND. [7]Dept. of Geology and Geography, Georgia Southern Univ., Statesboro, GA.

Introduction: Catastrophic impacts have channeled the course of evolution of life on Earth. The most recent event took place 65 Myr ago when a ~10 km object impacted off the Yucatan Peninsula, Mexico, leading to a mass extinction at the end of Cretaceous period [1-4]. The main belt source region for the K-T impactor has been a mystery until recently.

A new dynamical model [5] revealed a probable source region of the K-T impactor in the parent body of asteroid 298 Baptistina which was catastrophically disrupted ~160 Myr ago creating the Baptistina Asteroid Family (BAF). A key line of evidence linking 298 Baptistina and the K-T impactor was their similar composition (CM2 carbonaceous chondrites) [5]. Composition of the Baptistina family was assumed to be C/X-type based on visible spectra of (298) Baptistina and another bright family member [6] as well as SDSS colors of numerous fainter objects in the family itself. [6]. Baptistina's visible spectrum clearly shows a hint of a weak 0.9-μm feature suggesting an S-type classification rather than a C/X type. The lack of albedo information made it difficult to confirm its taxonomic type.

Observation/Data Reduction: In order to better constrain its composition and albedo, an observation campaign was launched in Feb.-Mar., 2008 using the NASA IRTF. Baptistina was observed with SpeX on Feb. 28, and March 21 and 22 UT in prism (0.7-2.5 μm) and cross dispersion (1.9-4.2 μm) modes. The prism data were reduced using IRAF and SpecPR and LXD data using an IDL routine developed by Emery.

Analysis: Figure 1 shows the average spectrum of 298 Baptistina from March 21 (0º) & 22 (180º) at opposite rotational phases. The spectrum shows a well-resolved Band I at 1.0±0.01 μm (depth 7±1%) and a weaker (depth 2±1%) Band II at 2.0±0.2 μm.

Mineralogy: Based on the absorption features and the band parameters, the surface mineralogy of Baptistina includes olivine with traces of orthopyroxene (OPX). Olivine has a Band I center of ~1.0 μm and the weak Band II suggests traces of OPX. However, the absorption features seem to be severely suppressed or weakened hinting at a possible third phase. Weaker features could be due to the presence of 1) opaques (like metal, which can increase the albedo, 2) opaques (dark material like carbon, which suppress the features and reduce the albedo), 3) low-abundance of the absorbing species with moderate albedo, and 4) weakly featured minerals (low-Fe OPX or Enstatite or Forsterite). Given the mineralogy, 298 Baptistina is not a C/X type.

Albedo Estimate: The LXD data shows a rise in reflectance beyond 3.0 μm due to thermal emission. Using STM the estimated albedo is ~14^{+2}_{-3}%. The high errors are due to the scatter in the data because of poor weather conditions at the time of observations.

Meteorite Analogs: Based on the mineralogy and albedo possible meteorite analogs include pallasites, ureilites and metamorphosed CV/CO chondrites.

Implications for BAF and K-T Impactor Link: Based on the mineralogy and supported by the albedo information it is evident that 298 Baptistina is not a CM2 assemblage. This would appear, at first glance, to weaken the link between the Baptistina family and the K-T impactor. On the other hand, it may also hint at some intriguing possibilities. For example, if the Baptistina family is indeed C/X-complex and assuming (298) Baptistina is not an interloper, it could mean that (298) Baptistina is (i) a remnant core of the original parent body or (ii) a remnant of the impactor that destroyed the parent body. Spectral analysis of other BAF members is currently underway to probe this mystery.

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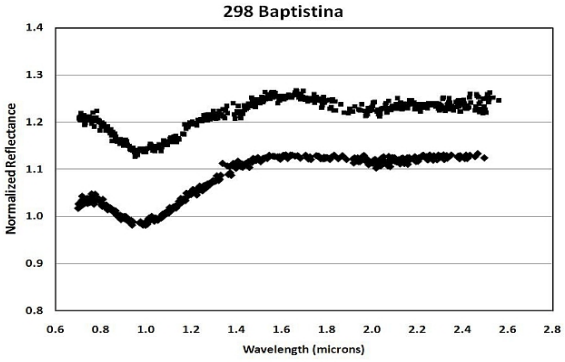

Figure 1: Near-IR spectrum of 298 Baptistina obtained using the SpeX instrument on NASA IRTF on March 21 UT (bottom) and March 22 UT (top), 2008.