A COMPREHENSIVE ATLAS OF ASTEROID (101955) BENNU. K. S. Coles[1], C. A. Bennett[2], D. S. Lauretta[2], C. W. V. Wolner[2], [1]Geoscience, Indiana Univ. of Pennsylvania (Indiana, PA, 15705 USA, kcoles@iup.edu), [2]Lunar and Planetary Laboratory, Univ. of Arizona, Tucson, AZ, USA.

Introduction: The Atlas of Bennu will use maps, images, artwork, data plots, and linked multimedia to illustrate the results from the OSIRIS-REx mission's encounter with near-Earth asteroid Bennu. The target audience for the atlas includes specialists and other scientists seeking an overview of the mission and its results, as well as other persons interested in what we have learned by exploring Bennu and what it tells us about the solar system and the origin of life on Earth. After a brief review of asteroids, meteorites, and the record of solar system history that they provide, the atlas will present the following information:

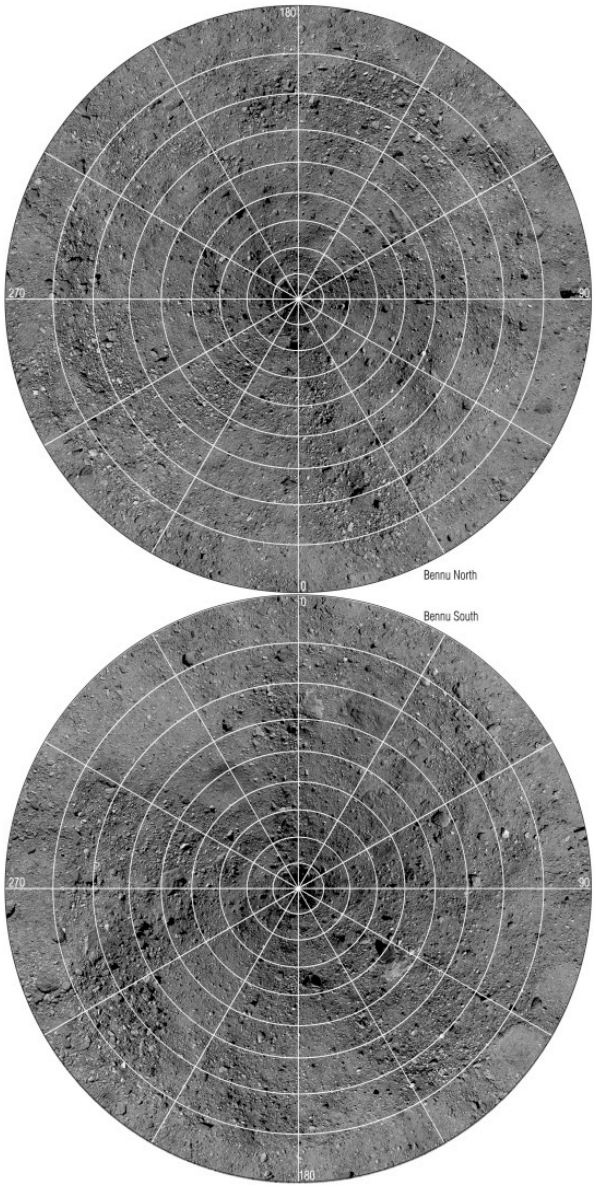
Mission and Target Overview: The overview opens with the mission objectives, mission profile, and the design of the spacecraft [1]. A description of the global properties of Bennu incorporates observations from Earth and by OSIRIS-REx. Explanations of the coordinate system for the surface of Bennu and the naming conventions for surface features [2] will help the reader follow the subsequent presentation of key mission results.

Mission Results: *Survey of Bennu.* The spacecraft survey of Bennu that enabled the selection of candidate sample collection sites provided detailed information on surface geometry and roughness, internal architecture, thermal properties, albedo and color variation, mineralogy, impact structures, and gravity-driven processes [3, 4].

The atlas will present detailed maps of the surface (e.g., Fig. 1) with overlays illustrating these properties and processes. It will also highlight observations that refine our understanding of (a) the YORP and Yarkovsky effects that influence the rotation state and orbit of Bennu [6–8], (b) the discovery of repeated ejection of particles from Bennu and possible mechanisms thereof [9, 10], (c) the detection of widespread carbon-bearing material including organics and carbonate minerals [11, 12], and (d) the presence of unusually bright, pyroxene-bearing rocks on the surface of Bennu that appear to have originated from asteroid Vesta [13].

Selection of Sample Site; Sampling. The process of selecting candidate sites for surface sampling and narrowing down to the top choice (Nightingale; Fig. 2) is featured in the context of the encounter studies [14]. The properties of the chosen site and inferences about the sampling itself will provide necessary context to comprehend the analyses of the sample that will take place once it has been returned to Earth, by which time we plan to have released the atlas.

Figure 1. The global basemap of Bennu displayed in polar stereographic projection [5]. The top map shows latitudes spanning 0° to 90°, and the bottom map shows latitudes from 0° to –90°. Both maps have latitude grid lines in 10° increments, which start from 0° at the outermost mark.



Special Features: The atlas will incorporate stereo views of Bennu. Links to multimedia, including videos and animations, supplement the text and illustrations [15].

References: [1] D. S. Lauretta et al. (2017) Space Sci. Rev., doi:10.1007/s11214-017-0405-1. [2] planetarynames.wr.usgs.gov. [3] D. S. Lauretta et al. (2019) Nature, doi:10.1038/s41586-019-1033-6, and references therein. [4] References in K. T. Smith & K. V. Hodges (2020) Science doi:10.1126/science.abf2271. [5] C. A. Bennett et al. (2020) Icarus, doi:10.1016/j.icarus.2020.113690. [6] S. R. Chesley (2014) Icarus, doi:10.1016/j.icarus.2014.02.020. [7] W. F. Bottke et al. (2015) Icarus, doi:10.1016/j.icarus.2014.09.046. [8] C. W. Hergenrother et al. (2019) Nat. Commun., doi:10.1038/s41550-019-0731-1. [9] C. W. Hergenrother et al. (2020) JGR Planets, doi:10.1029/2020JE006549, and references therein. [10] D. S. Lauretta, C. W. Hergenrother, et al. (2019) Science doi:10.1126/science.aay3544. [11] A. A. Simon et al. (2020) Science, 370, doi:10.1126/science.abc3522. [12] H. H. Kaplan et al. (2020) Science, 370, doi:10.1126/science.abc3557. [13] D. N. DellaGiustina et al. (2020) Nat. Astron., doi:10.1038/s41550-020-1195-z. [14] D. S. Lauretta et al. (in press), in Sample Return Missions, ed. A. Longobardo (Elsevier). [15] Examples at www.asteroidmission.org/galleries/.

Figure 2. Global basemap of Bennu in equirectangular projection [5] showing a subset of the numerous initial sample sites (circles) which were under consideration after the Detailed Survey global observation campaign. The final four candidate sample sites are numbered: 1: Nightingale; 2: Osprey; 3: Sandpiper; 4: Kingfisher.