Introduction: Europa and Enceladus (or their precursors) likely accreted over an extended period of time (>0.1–1 Myr) somewhat inward of their present distances from the Sun, in a circumjovian or circum-saturnian nebula (as appropriate) formed during the end stage of the solar nebula [1–4]. Chemical and isotopic data from Enceladus and Titan can be interpreted to imply that the material from which Enceladus formed was essentially protosolar in nature, trapped in satellitesimals that might have had a common origin with some classes of comets, and transported into the satellite feeding zone without significant subsequent chemical or isotopic interaction with saturnian subnebular gas [5]. For Europa it is likely (almost certain?) that chemical and isotopic interaction with protojovian subnebular gas did occur [6], because Europa’s ice/rock ratio is so much lower than either that of Ganymede or Callisto (ice vaporization pre-accretion being an obvious fractionation mechanism). Vaporization of highly volatile ices and organics would have accompanied infall from the solar nebula into the jovian subnebula, and might have occurred during infall into the saturnian nebula [e.g., 1], but in the case of Enceladus ammonia-ice survived and was accreted along with carbon-bearing ices (CO$_2$ at least) [7]. Carbonaceous matter accreted as well, CHONPS being an important additional source for nitrogen along with sulphur and phosphorus (important biogenic elements) [8].

In terms of initial rock chemistry and mineralogy, recent theoretical models suggest that CM- and CV-like carbonaceous parent bodies accreted just outside Jupiter’s orbit and such solid material would have fed the accretion of the jovian satellites [9–11; E.D. Young, pers. comm., 2018]. In contrast, CI chondrites, the most volatile and carbon-rich chondrite class, may have accreted farther out, potentially nearer to Saturn [11]. In this case this rock type may be the best representative we have of the “rock” that went into Enceladus (and Titan). None of these rock types have the carbon or organic content thought representative of cometary dust. Moreover, the Enceladus we see today may be a surviving remnant of a larger, precursor satellite torn apart by saturnian tides, or possibly a “cosmic hairball” coughed up by a long evolving and much more massive ring system, and in either case may be substantially younger than 4.5 billion years old [e.g., 12].

In this presentation, we will assess these origin and compositional possibilities, and what they imply for the history and style of ocean-rock interactions on Europa and Enceladus [13–15]. Emphasis will be placed not on theoretical fine points (uncertain), but what can be tested, especially by Europa Clipper, the possible future Europa Lander, and potential Enceladus plume fly-through missions. Enceladus and Europa have most likely followed different paths. Enceladus’ core appears to be (still!) compositionally primitive and porous [16–18], whereas the age, pressures and temperatures with Europa’s core lead naturally towards metallic core formation, loss of global porosity, and basaltic seafloor volcanism within a lower-Mg#' ultramafic mantle.