A Larsen C core sediment record history unravels Snowball Earth hypothesis

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Abstract

A marine geological expedition (ARA13 cruise expedition) was conducted in the Larsen ice shelf B and C embayments of northwestern Weddell Sea (66^0 3.89832'S, 60^0 27.69212'W) in 2013. In particular, Larsen C ice shelf C embayment, inaccessible region since 2005, permitted the marine geological discoveries. We collected a marine sediment core (EAP13-GC16B, 203 cm in length) on the northwestern part of Larsen C ice shelf. The sediment core provides a unique style of lamination and massive diamictons and is composed of four distinct lithological units, from top to bottom: the upper 21 cm (unit 1) is characterized by sandy diamicton with calcareous foraminifera. The interval from 21 to 90 cm (unit 2) consists of finely laminated, sandy, clayey silt. From 90 to 194 cm (unit 3), the mud is characterized by slightly sandy, silty clay laminations. Below the 194 cm (unit 4), the basal unit of stratigraphy consists of the structureless diamictons. Based upon sedimentological, geochemical, and paleontological data with AMS (foraminifera) and ramped pyrolysis ^{14}C datings the oceanic and glacial changes are reconstructed and are involved with the transitions from glacial through sub-ice shelf to open marine condition since the Last glacial Maximum. The sedimentary sequence may be an important key to elucidate ancient strata of Neoproterozoic age found on several continents. We present extended data ($\delta^{13}C$, $\delta^{15}N$, Fe and Br counts from ITRAX scanning, illite crystallinity, ^{10}Be isotopes, and lamination counts) of laminated sediment (unit 3) linked with sub-ice shelf environment. The Larsen C core records compared to the previous results inferred on laminated rocks of Neoproterozoic age provides a direct and crucial evidence to resolve the paradox of dropstone-free, laminated sediments with massive ice-proximal diamictites. It will be also analogous to ancient strata founded sub-ice shelf ironstone deposition during the Neoproterozoic glaciation considered to be a severe glaciation in Earth history.

Keywords: Larsen C ice shelf, marine sediment core, sub-ice shelf ironstone deposition, Snowball Earth hypothesis