

## Collaborative studies for locating the oldest ice near Dome Fuji, Antarctica

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International Partnerships in Ice Core Sciences (IPICS) sets a priority project "Oldest Ice Core," which states the importance of drilling multiple ice cores in Antarctica to cover more than one million years. Previous studies have indicated that such old ice may exist in the Antarctic interior.

This presentation introduces ongoing, international collaborative studies for locating the oldest ice near Dome Fuji. In 2016, an international workshop was held to plan collaboration between Japan, U.S. and Norway for a ground-based site survey in the Dome Fuji area, as well as its collaboration with German airborne survey (as a Beyond EPICA activity). In 2016/17 austral summer, the airborne radar survey was conducted by Alfred Wegener Institute, and the data was kindly shared with the Japan-US-Norway for selecting areas for the ground-based survey. In the 2017/18 summer, 59<sup>th</sup> Japanese Antarctic Research Expedition (JARE) conducted a suite of glaciological studies, including a ground-based radar survey in three areas around Dome Fuji with 5-km line spacing, and three shallow ice corings (40 to 152 m depth). The survey areas were determined based on discussion among international colleagues.

Based on the radar data of AWI and JARE 59, one-dimensional ice-sheet modelings started independently in Japan and Norway to interpret the respective radar data and to estimate the age of ice near the bed. The outcomes of the radar data and modeling results were used to narrow down the target areas for the Japan-US-Norway international survey using higher-performance U.S. ice radars together with the JARE radars with improved antennas. The international survey was in the 2018/19 summer, including the ground-based radar survey in the south of Dome Fuji, one shallow coring, firn air sampling, and surface mass balance and flow observations.

From the series of data and models, the following outcomes and investigations will at least be necessary to locate the oldest ice around Dome Fuji.

- creating most detailed bedrock map (from radar data)
- full processing of radar data to resolve internal layers within ice near the bedrock
- layer tracking and their age estimation (combining deep radar data, Dome Fuji ice core and 1-D model)
- spatial distribution of surface mass balance (from shallow-depth radar data)
- 1-D ice flow modeling (both forward and inversion)
- 3-D ice flow modeling (for the possibility of dome migration and effect of horizontal flow to deepest layers)

The discussion of the oldest ice will place particular importance on the full examinations of deepest layers in the U.S. radar data after advanced processing, with the aid of ice-sheet modeling and the past Dome Fuji ice cores to inform us on the age and flow in the studied area.

Essential criteria for including a location in further consideration as the oldest ice site may be the following (note this list itself is the subject of discussion).

- lack of obvious or suspected basal melting
- no indication of flow disturbance (folding) or refrozen ice
- smooth visible layers near the bed (within a hundred meters or so)
- relatively old age near bedrock (from layer tracking)
- old age from 1-D modeling
- small effect of horizontal flow (in case of dome migration) from 3-D model
- relatively low accumulation rate

For reference, after locating the oldest ice site hopefully by late 2020, the next steps will be to transport materials and fuel, establish the drilling station, and to prepare for the deep drilling by the end of 2021/22 summer season. The actual deep drilling near Dome Fuji is proposed by the Third Dome Fuji Project Promotion Committee and JARE to start in the 2022/23 austral summer and continue for a few years to reach the bedrock.

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