

The 8th International Ice Drill Symposium



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The brittle ice zone in polar ice cores

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The brittle ice zone (BIZ) is a persistent challenge for deep and intermediate-depth polar ice core projects. Increasing ice overburden at depth pressurizes trapped air bubbles, resulting in fracture of ice cores as they are drilled brought to the surface. Only at depths/pressures where air bubbles fully transition to clathrates is this breakage relieved. Ice core fracturing has negative downstream impacts in sampling and analysis, causing contamination and degrading scientific results. The international ice core community has encountered the BIZ at many sites; data from 18 polar locations was documented and published after discussions beginning at the 7th International Workshop on Ice Drilling Technology. The BIZ begins at a mean depth of 545 +/- 162 m (1 standard deviation), extending to depths where ductile clathrate ice is reached: an average of 1132 +/- 178 m depth. Due to variations in ice thickness and snow accumulation rate, ages at depth in the BIZ range from as young as 2 ka before present (BP) at Dye-3, Greenland to >160 ka BP at Taylor Dome, Antarctica. At intermediate depth ice core sites, up to 90% of the paleoclimate record can be compromised. Exploring the effects of temperature and pressure on the BIZ reveals complex relationships between firn densification and BIZ depth, qualitatively supporting expected thinning of the BIZ at lower temperature due to shallow clathrate stability in such environments. BIZ results published in 2014 are updated here to include ice coring completed in the last five years.

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