Development and application of biomass burning tracers in ice core for reconstruction of boreal forest fire history in North America
（森林火災トレーサーの評価とアイスコアを用いた過去の北アメリカ北方林の森林火災の変遷の復元）

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Abstract: Biomass burning, which includes wildfires and other types of fires involving plant matter, emits large amount of numerous greenhouse gases and aerosols into the atmosphere. Understanding the fire regimes, especially in boreal forest is important as, boreal forest contains one third of world's forests, and an important source of air pollutants throughout the Arctic. Hence, it is important to precisely reconstruct long-term variability of boreal fire associated with climate change for improving predictions of the impact of future climate changes on boreal fires. And for this, well-dated biomass burning tracer records are needed to study the link of climatic with boreal forest fire in the past. Forest fire activity in a past could be reconstructed by analyses of biomass burning tracers (levoglucosan and dehydroabietic acids) in paleoclimate archives such as ice core. Levoglucosan is a marker of biomass burning and dehydroabietic acid is a specific tracer of conifer tree burning. In recent years, these tracers have been applied to few ice cores to reconstruct the variability of such aerosol loadings in the past. However, paleoclimatic utility of these tracers in ice core has not been evaluated well.

Thus, we assess the paleoclimatic utility of the biomass burning tracers in Greenland ice core (SE-Dome ice core). Comparison of biomass burning tracers in the SE-Dome ice core with area burned events in a possible source region of biomass burning aerosol suggests that the ice core tracer records document most of the

pronounced biomass burning events in eastern Canada. This confirms that analyses of the biomass burning tracers in Greenland ice cores are promising approach to reconstruct the frequency of significant biomass burning events in regional scale.

Next, we applied the two tracers to ice cores collected from northwestern Greenland (Sigma D) and southern Alaska (Aurora peak) to reconstruct the boreal forest fire history in North America over the past few hundred years. The both ice core records indicate that significant boreal forest fire events happened frequently in Alaska and Canada over the past 300 years with increases in boreal fires during Little Ice Age and the recent decades. Comparison of regional temperature and ice core biomass burning tracer records indicates that regional temperature is the major driver intensifying the fire in Canada and Alaska on decadal timescales, as prominent peaks of biomass burning tracers well correspond to the regional climate warming periods. In addition, changes in the decadal scale climate oscillations such as North Atlantic Oscillation (NAO), likely exert an influence on fire dynamics in eastern Canada, by increasing aridity. On the other hand, strong link between decadal scale climate oscillations and boreal fire is not recognized in the western boreal region over the past 300 years. The coupling of boreal fire and regional temperature for the last 300 years, suggest that occurrence frequency of boreal forest fire will increase in a future due to the ongoing global warming.