Sudden onset of Northern Hemisphere glaciation at 2.65 Ma: A possible result of volcanic forcing

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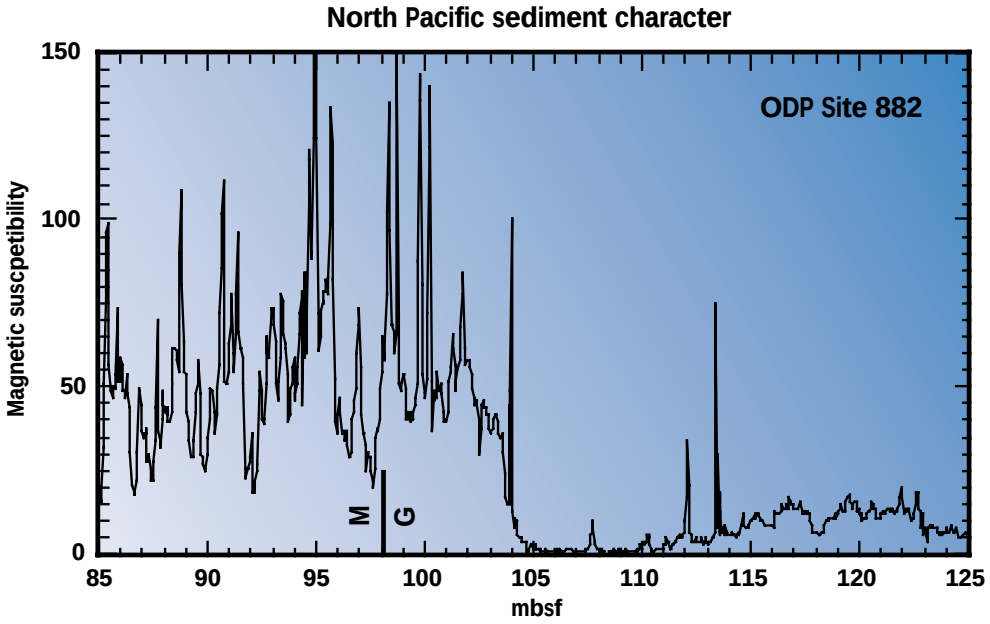
Ocean drilling in the subarctic Pacific during ODP Leg 145 recovered high-resolution records of the onset of Northern Hemisphere glaciation. Cores from Detroit Seamount in the northern Emperor Seamount chain and from Patton-Murray Seamount in the Gulf of Alaska show the transition from nearly pure siliceous oozes that characterize preglacial times to ash-, clay-, and ice rafted debris-rich ooze of the glacial ages was very sudden, a matter of at most one or two thousand years [*Rea et al.,* 1995]. The transition occurs everywhere at 2.65 Ma and records a sudden change in continental weathering and erosion all around the North Pacific basin.

Since the rate of change is an indication of cause, both tectonic forcing, which requires many hundreds of thousands of years, and orbital forcing, which requires ten or more thousand years, seem to be ruled out as direct causes of the 2.65 Ma onset of Northern Hemisphere glaciation. Therefore we have turned our attention to the period of intense volcanic activity that began all around the North Pacific at exactly this same time. The Kamchatka Peninsula is the largest Plio-Pleistocene volcanic field, is situated at a climatically sensitive latitude, and began its eruption at the same time as the change in sediment characteristics. For instance, Plio-Pleistocene sediment at Site 882 on Detroit Seamount, a paleo-distance of 1000 km from the Kuril-Kamchatka Arc, contains significant disseminated ash and 60 distinct ash layers, a dozen of which are over 10 cm thick. In the past two decades we have learned that high latitudes are very sensitive to volcanically-induced cooling and ice-core data have showed that significant climate changes occurred on the years to decades timescale of volcanic forcing. Thus the very rapid onset of Northern Hemisphere glaciation recorded in the Leg 145 drill cores ultimately may have had a volcanic cause, perhaps just enough to tip an already cooling world over to a full glacial regime.

References:
Rea, D.K., I.A. Basov, L.A. Krissek, and the Leg 145 Scientific Party, Scientific results of drilling the North Pacific transect, In: D.K. Rea, I.A. Basov, D.W. Scholl, J. Allan, et al., *ODP Proc., Sci. Results, 145,* 577-596, 1995.



Magnetic susceptibility record from northwestern Pacific ODP Site 882 illustrating the preglacial to glacial sediment transition at 2.65 Ma. The transition from nearly pure diatomaceous ooze below 104 mbsf (meters below seafloor) to clay, ice rafted debris, and ash-rich sediment above occurs over 10 cm of section where the linear sedimentation rate is 10.7 cm/ky. Most of the spikes in this record indicate either ash layers or dropstones. The heavy line labeled M/G denotes the position of the Matuyama-Gauss magnetic reversal boundary of 2.60 Ma.