

Magnetic Evolutions at Extremely High Latitude Region during Polarity Reversal Observed with Hinode

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The magnetic field in the Sun's polar region is a key ingredient of the solar dynamo mechanism because the polar field strength at a solar minimum has a correlation with solar activity of the following cycle. The evolution processes of the polar field (its polarity reversal and its build-up after the reversal) are thought to be caused by magnetic flux transport due to meridional flow and diffusion by turbulent convection. Nevertheless, our understanding of the meridional flow and diffusion in the polar region is still poor because of many difficulties in magnetic observation near the limb.

We recorded time evolution of magnetic polarity distribution within the whole of both polar regions derived from the high-accuracy spectropolarimetric observation with Solar Optical Telescope aboard Hinode. In the north polar region, the latitudinal polarity inversion line (PIL) between the preexisting negative polarity region and transported positive polarity region migrates from 60 degrees latitude at January 2012 to 68 degrees latitude at September 2012. Then the whole of the north polar region becomes positive at September 2013. The migration speed of the PIL is 5 m s^{-1} (January - September 2012) and then becomes 8.5 m s^{-1} (September 2012 - September 2013). According to a flux transport model, the speed-up is understood as a result of a diffusion process. In contrast, the whole of the south polar region observed in March 2013 has still ample positive field. The PIL locates out of the observed region (over 67 degrees latitude).

We examined a few parameter sets of the meridional flow pattern and the diffusion coefficient with an advection-diffusion model. The observed PIL migration in the north polar region can be explained well if there is slightly strong diffusion without the meridional flow.

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