Challenging the FIP Bias Paradigm?

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Plasma composition is a critical plasma parameter linking coronal source regions to solar wind streams. We typically characterize plasma composition using first ionization potential (FIP) bias which is the ratio of elemental abundance in the upper atmosphere to that in the photosphere. Though the in situ determination of plasma composition is well established, the solar side has not significantly evolved since the seminal Skylab results. Using spectroheliograph observations from Skylab, Widing & Feldman (2001) demonstrated plasma trapped in coronal loops in newly emerged active regions (ARs) has photospheric composition (FIP bias ~ 1) and from thereon the AR plasma becomes enriched at an almost constant rate per day so that after 2-3 days coronal and slow solar wind abundances are reached (FIP bias ~3-4).

Hinode/EIS has provided a new opportunity to re-examine the evolution of plasma composition in ARs at the highest temporal and spatial resolutions. Using Hinode/EIS large field-of-view, high resolution composition ratio maps of a large, decaying AR (NOAA 11389), we found the evolution of composition to be counter to the prevailing paradigm that plasma enrichment in ARs is linearly related to AR age. Even in an aging AR, FIP bias is modulated by small-scale flux emergence. This result has possible implications for what is observed in the slow solar wind.