M13b Resistive Processes in the Preflare Phase

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We study the resistive processes running in the preflare phase of eruptive flares by 2.5-dimensional MHD numerical simulations. In this study, we start with a 2.5-dimensional force-free current sheet in an uniformly distributed resistivity, associated with a very small random velocity perturbation. Then the evolution enters on the linear stage of the tearing instability and later produces a sufficient amount of thermal energy at the nonlinear saturation stage, corresponding to the preflare heating. As the nonlinear saturation proceeds, those magnetic fields which are perpendicular to a 2-dimensional current-sheet plane (perpendicular magnetic fields) flow away from nearby a X-point formed in a current sheet and eventually cause the current-sheet collapse at this point. This collapse makes the current density through the current-sheet plane enhanced about (1 + 1 / beta) times so that the thickness of current sheet is greatly reduced in such a low-beta region as the solar corona (beta is the so-called plasma beta). It is found that the effect of the current-sheet collapse is fairly strong especially in those regions where the magnetic Reynolds number is large and the force-free equilibrium is achieved. Since the existence of very thin current sheet leads to the occurrence of the anomalous resistivity, the transition from the gradual energy-release phase in an uniformly distributed resistivity to the violent one in a locally enhanced anomalous resistivity can be accomplished, leading to the fast-magnetic-reconnection stage responsible for violent explosive phenomena in the sun.