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A new technique for probing thermal alteration in paleointensity studies: double thermal demagnetization of 3-components of ARM

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It is well known that changes in thermal remanent magnetization (TRM) due to thermal alteration of magnetic grains are the main reasons to result in failure in traditional type paleointensity studies. Blocking temperature (T_b) and/or unblocking temperature (T_{ub}) of magnetic carriers are the comprehensive parameters in evaluating such changes. Both blocking and unblocking temperature are functions of saturation magnetization (J_s), volume (v), coercivity (h_c) of magnetic grains, as well as interaction between grains such as those we recently identified. Traditional comparison of ARM (anhysteretic remanent magnetization) before and after heating cannot detect thermal alteration of a rock for CERTAIN, because the ARM acquired in room temperature is a function of coercivity of grains only. However, in the case of thermal demagnetization of ARM, because the unblocking temperature spectra of ARM are also the function of T_{ub} of grains, stepwise thermal demagnetization of ARM can potentially probe thermal alterations occurred in magnetic grains.

We have recently developed a double thermal demagnetization of 3-components ARM technique for checking thermal alteration in paleointensity determination experiments. By comparison thermal demagnetization curves of ARM before and after a given maximum temperature T_n, it is possible to check whether thermal alteration has occurred. It is also possible to carry out a thermal alteration check at every successive thermal demagnetization step T_i by acquiring a new ARM at room temperature. Three components thermal demagnetization of ARM technique is thus very useful for distinguishing magnetic behavior of microphenocryst grains (which are crystallized in early stage before eruption of lava) and intersertal titanomagnetite grains (which are crystallized in secondary stage after eruption of lava). Microphenocryst grains generally have lower coercivity less than 30mT while intersertal grains have much higher coercivity. Thus the softest ARM component (h_c lower than 10mT) is dominant by microphenocryst grains; the mild component (h_c =10~30mT) may contain both microphenocryst and intersertal titanomagnetite grains; and the hard component (h_c higher than 30mT) is dominated by intersertal titanomagnetite grains. We will illustrate the above mentioned points by case studies of Columbia River Basalts (CRB) at the meeting.