

New constraint for the extrusion of Indochina: Late Cretaceous paleomagnetic evidences from the Viet-Lao terrane, northern Vietnam

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We present paleomagnetic results from the Upper Cretaceous Yen Chau Formation at locality Yen Chau (21.0 degrees N, 104.4 degrees E) and Lai Chau (22.3 degrees N, 103.4 degrees E) in northwestern Vietnam. The study area is a part of the Viet-Lao terrane. This terrane constitutes of the northeastern part of the Indochina Block, which borders on the South China Block along the Red River fault, on the Simao terrane along the Dien Bien Phu fault to the west, and on the Khorat-Kontum terrane along the Song Ca fault to the south. The high temperature component of magnetization with the unblocking temperature between 600 and 690C was isolated after thermal demagnetization from 15 sites. Directions of the high temperature components at locality Yen Chau reveal a positive correlation test at the 99 percent confidence level and dual polarity. Directions of high temperature components at locality Lai Chau reveal a positive correlation test at the 95 percent confidence level. These facts indicate the primary nature of the high temperature components. The corresponding poles at two localities are statistically indistinguishable from each other at the 95 percent confidence level. Therefore we recognize an overall mean of these primary magnetizations as the Late Cretaceous remanent magnetization of the Viet-Lao terrane. The tilt corrected overall mean direction of 15 sites is $D=1.4$ degrees, $I=28.3$ degrees ($\alpha_{95}=11.4$ degrees), with a corresponding pole at 83.6 degrees N, 259.0 degrees E ($A_{95}=9.8$ degrees). This pole position is indistinguishable from Late Cretaceous pole of the South China Block at 95 percent confidence level. This indicates that the Viet-Lao terrane experienced no significant movement with respect to the South China Block since Cretaceous. In contrast, the positions of Cretaceous poles of the Khorat-Kontum terrane and Simao terrane indicate significant southward displacements (~1,500 km) and clockwise rotations (~30 degrees) of these terranes with respect to the Viet-Lao terrane. Our result reveals that Indochina consisting the Khorat-Kontum and Simao terranes extruded to the southeast along the Song Ca suture and Dien Bien Phu fault, whereas the Viet-Lao terrane behaved as a stable tectonic unit together with the South China Block during the extrusion of the Indochina.