Serpentinized cold mantle wedge beneath southern Mexico : new insights from thermal models and magnetic anomalies

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Southern Mexico is a very interesting area where the subducting Cocos slab drastically changes its geometry: from a flat slab in Central Mexico to a ~ 45º dip angle beneath Chiapas. Also, the currently active volcanic arc, the modern Chiapanecan volcanic arc, is oblique and situated far inland from the Middle America trench, where the slab depth is ~ 200 km. In contrast, the Central America volcanic arc is parallel to the Middle America trench and the slab depth is ~ 100 km. A 2D steady state thermo-mechanical model explains the calc-alkaline volcanism by high temperature (~ 1300º C) in the mantle wedge just beneath the Central America volcanic arc and strong dehydration (~ 5 wt.%) of the Cocos slab. In contrast, the thermal model for the modern Chiapanecan volcanic arc shows high P-T conditions beneath the coast where the Miocene Chiapanecan extinct arc is present, and is therefore unable to offer a reasonable explanation for the origin of the modern Chiapanecan volcanic arc. We propose a model in which the origin of the modern Chiapanecan volcanic arc is related to the space-time evolution of the Cocos slab in Central Mexico. The initiation of flat subduction in Central Mexico in the middle Miocene would have generated a hot mantle wedge inflow from NW to SE, generating the new modern Chiapanecan volcanic arc. Because of the contact between the hot mantle wedge beneath Chiapas and the proximity of a newly formed cold flat slab, the previous hot mantle wedge in Chiapas became colder in time, finally leading to the extinction of the Miocene Chiapanecan volcanic arc. The position and the distinct K-alkaline volcanism at El Chichón volcano are proposed to be related to the arrival of the highly serpentinized Tehuantepec Ridge beneath modern Chiapanecan volcanic arc. The deserpentinization of Tehuantepec Ridge would have released significant amounts of water into the overlying mantle, therefore favoring vigorous melting of the mantle wedge and probably of the slab.