Rate of Horizontal Fault Displacement in New Zealand

WELLMAN[1] has estimated horizontal faulting rates in New Zealand. His presentation, however, takes little heed of published data relevant to recent crustal movements in New Zealand and his inferences are extremely tenuous.

Wellman states: "From seafloor spreading . . . the rate [of horizontal displacement] is estimated to be about 34 mm per year" and quoted Christoffel[2] and Wellman[3] in support. Christoffel, however, estimated "relative average rate of movement between 4.2 and 5.8 cm a year". The estimate of 34 mm per year is Wellman's alone.

In estimating an age of 10,000 yr for the Waiohine and other aggradation surfaces Wellman ignored the radiocarbon dates from which the dating of correlative aggradation surfaces in the South Island has been developed. These dates[4,5] indicate an age of about 18,000 yr for the latest principal aggradational surfaces developed during the latest (Otira) glaciation.

Wellman stated that at Turakirae Head "the highest [beach] ridge seems to be roughly 6,300 yr old. Radiocarbon dating of samples from beds a few metres below the highest beach ridge supports this estimate". In fact the radiocarbon dates referred to[6] are from a different section on a different structure 70 km away across the regional strike of several important structures, and the dating of the beach ridge depends on complex relations of tectonism and sea level rise[7].

We are unaware of the evidence on which Wellman bases the active dextral fault shown offshore off the southeast of the North Island; this was first postulated in 1971 by Wellman[8] without any substantiation. Later[3] in 1971 he merely noted that it was "reasonably well-defined by bathymetry to the northeast".

Wellman's assumption of a constant average rate of vertical movement ignores the evidence[9] of decreasing rate and reversals of vertical movements at many active faults since the formation of the last main aggradational surface. This makes calculations based on rates of vertical movement suspect. Wellman has to assume a changing average rate of horizontal movement at Waiohine rather than the constant rate for transcurrent faults in general that he has accepted previously[10,11].

The Cape Turakirae beaches lie on the anticlinal fold between the Wellington and Wairarapa Faults. Uplift there will result whenever accumulated strain along the fold is relieved by triggering from earthquakes associated with movement at any of the major faults in the region, not only at the Wairarapa fault, which displaces the Waiohine terraces. Uplift at Turakirae may thus be significantly more frequent than movement on the Wairarapa Fault at the Waiohine terraces. Wellman's inference that the same earthquakes caused movement in both places is not valid.

Wellman's ratio will remain the same if a constant factor exists relating frequency of uplift at Turakirae to faulting at Waiohine. No inference of age of the Waiohine surface and by extension of the rate of horizontal movement is possible without knowledge of such a factor. The Waiohine surface could well be several times older than Wellman assumes.

If one were to accept Wellman's 240 m summation of post-aggradation movement at the major faults, and an age of 18,000 yr for the latest principal aggradation surface, the rate of strain would be 13 mm yr^{-1}. This is little more than one-third of Wellman's estimate of 34 mm yr^{-1} and an even smaller part of either of Christoffel's estimates, all from seafloor spreading. Conversely, for Wellman's rate of 34 mm yr^{-1} the principal aggradation surfaces must be 7,000 yr old, which is unrealistic.

Suggate[12] has maintained and Freund[13] has accepted that there is no good evidence of large horizontal displacements in post-glacial time along the central section of the Alpine Fault, where Wellman's reconstruction would require the rate of strain (34 mm yr^{-1}) to be the sum of the rates on the faults of the shear belt to the northeast. Freund[13] has put forward one possible hypothesis whereby the horizontal movement on these faults need not be transmitted to the Alpine Fault.

We urge those dependent on published literature for their knowledge of Recent crustal movements in New Zealand to study that literature as fully as possible. New Zealand's key position in relation to floor spreading makes such a study necessary.

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Magnetism and Archaeology

A RECENT discussion about reversed geomagnetic events in the Brunhes epoch contains the statement that no archaeological materials are known to be reversely magnetized[1]. This may be true for the specific region that is considered in the article, but it is not true in general. G. Folgheraiter in "Rendi Conti dei Licei", 1896, 1899; *Archives des sciences physiques et naturellas* (Geneva), 1899; *Journal de physique*, 1899; and P. L. Mercanton, in "La methode de Folgheraiter et son role en geophysique", *Archives des sciences physiques et naturellas*, 1907, reported observations made on clay fired in kilns by the Etruscans and Greeks. Their results indicate that in the eighth century BC the Earth's magnetic field was reversed.

In 1896 Giuseppe Folgheraiter made studies of Attic (Greek) and Etruscan vases of various centuries, starting with the eighth century BC. The observations were made on clay fired in kilns. The position of the ancient vases during firing is known. They were fired in a standing position, as indicated by the flow of the glaze. The magnetic inclination or the magnetic dip of the iron particles in the fired clay indicates the nearest pole during time of firing. His conclusion was that in the eighth century BC the Earth's magnetic field was reversed at least in Italy and Greece.

P. L. Mercanton of Geneva, studying the pots of the Hallstatt age from Bavaria (about 1000 BC) and from the Bronze Age caves in the region of Lake Neuchâtel, came to the conclusion that about the tenth century BC the direction of the magnetic field differed only slightly from its present direction. His material was of an earlier date than that used by Folgheraiter but, checking on the method and results of Folgheraiter, Mercanton found them correct[2].

This work has been brought to the attention of Elizabeth K. Ralph, Associate Director, the University of Pennsylvania Museum, who is presently investigating magnetic field reversals. She is considering investigation of material taken from kilns dating around the eighth century BC. These kilns were recently unearthed in Sarepta by James B. Pritchard who is also asso-