

Reconstruction of vertical crustal movement at the Anden Coast, Oga Peninsula during the last 500 ky using the focusing method

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Introduction:

For geological and geographical evaluation of characteristics of crustal movements around the Japanese Islands during Quaternary, it is important to establish reconstruction method by which high-resolution crustal subsidence can be reconstructed, and to use the established method together with uplift reconstructing method using marine terraces. Utilizing relation between eustasy, vertical crustal movement, water depth change, and change in sediments thickness, a new reconstruction method to estimate (1) depositional ages of strata composing shallow marine sedimentary cycle, and (2) crustal uplift/subsidence rate, alternately is proposed (Shirai and Abe, submitted).

Reconstruction method:

Relative sea level at a location of interest is defined as the distance between a point fixed on the basement and the sea surface above the point. Therefore, the change in relative sea level is expressed as the combination of change in eustatic sea level and change in elevation of the basement. It is also expressed as a combination of change in water depth and change in thickness of sediments above the basement. Depositional ages of the strata and of the rate of vertical crustal movement are alternately restricted using relation between eustasy, elevation of the basement, water depth, and thickness of the sediment.

(i) Vertical crustal movement is guessed roughly by combining altitude of the basement during interglacial maximum in each glacial-interglacial cycle.

(ii) Subtracting roughly guessed vertical crustal movement from eustatic sea-level curve, relative sea level curve above the basement is calculated. Relative sea level is also estimated as sum of depositional depth and sediments thickness. Duration of correspondence between the two relative sea levels shows range of depositional age of each stratum.

(iii) Then, using estimated depositional ages of strata, altitudes of the basement estimated from every strata can be calculated. Vertical crustal movement is reconstructed as passing every range representing elevations of the basement.

(iv) Alternately repeating procedure (ii) and (iii), estimate of vertical crustal movement is restricted gradually.

Application of the focusing method to the Shibikawa and Katanishi formations:

The middle to upper Quaternary, the Shibikawa and Katanishi formations, are well exposed on the northern coast of the Oga Peninsula, northeast Japan. These formations are composed of six sedimentary cycles and intercalate four widespread tephros. Tephro-chronology and characteristics of sediments intercalating the tephros allow us to estimate depositional ages of the strata (Shirai and Tada, 2000). Therefore, vertical crustal movement can be reconstructed accurately (Shirai and Tada, 2002). Result of the application of the focusing method to the Shibikawa and Katanishi formations is compared with the results of reconstruction using tephro-chronology in order to examine validity of the result using focusing method.

Although estimates on depositional age of strata are not always focused, the rate of vertical crustal movement, which is estimated by using our method, is considerably consistent with the rate of vertical crustal movement estimated by using tephro-chronology. Taking account into that Quaternary tephro-chronology has not established perfectly yet, and that tephros may have been often eroded by wave action and so on in shallow marine environment, the proposed the focusing method is effective for estimating crustal uplift/subsiding rate when appropriate and minute chronological indices have not been known.