# Global seismology 2 (GEO-1509

## Hertentamen - 21 april 2005

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The numbers in () indicate the percentage for evaluation. No documents are allowed during the examination. Please write clearly and don't forget to indicate your name.

1. (10) Why are surface waves propagating in the real Earth dispersive?
2. (10) Why is attenuation with distance different from attenuation with time for surface waves and not for body waves?
3. (30) Suppose that a surface wave is of the form $e^{i(\omega t - kx)}$. Define and explain what the phase velocity is. In practice, waves with pure frequencies rarely propagate alone, but waves with neighbouring frequencies interfere with each other. Show how this phenomena leads to the concept of group velocity.
4. (50) The phase velocity $c$ for a given medium as a function of the wavelength $\lambda$ may be written as

$$c = c_0 - c_1 / \left[1 + \frac{(\lambda - \lambda_0)^2}{a^2}\right] \qquad for \quad \lambda \geq \lambda_0 \tag{1}$$

and

$$c = c_0 - c_1 + \frac{b(\lambda^2 - \lambda_0^2)^2}{\lambda_0^4} \qquad for \quad \lambda \leq \lambda_0 \tag{2}$$

where $c_0$, $c_1$, a, b and $\lambda_0$ are constants.

- (10) Draw the function c schematically (maxima, minima and asymtotic behaviour).
- (20) Show that the fundamental relation between group and phase velocity can be written as $u = c - \lambda \frac{dc}{d\lambda}$ and use this to draw schematically the group velocity as a function of $\lambda$.
- (20) We assume now that we have a station at a distance of 10000 km and give $c_0 = 5km/s$, $c_1 = 2km/s$, $b = 1km/s$ and $\lambda_0 = a/\sqrt{3} = 500km$. Describe the signal arriving at the station (period at some chosen characteristic times) given the group and phase velocity curves.

Good luck.