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Primary and Secondary magnetoseismic waves associated with Pi 2 magnetic pulsation

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In order to investigate the propagation mechanism of Pi 2 in the magnetosphere, we analyzed a Pi 2 event, which occurred around 1019UT on January 24, 1997. This Pi 2 event was observed at six stations located from high-latitude to near-magnetic equatorial region along 210 magnetic meridian. This event occurred under geomagnetically quiet state (Kp=1- and Dst = -7nT). Ultra Violet Imager data obtained by the Polar satellite indicated that an auroral breakup occurred around 68 GMLAT and 22.5MLT slightly before the Pi 2 onset, and this event was accompanied by an isolated substorm event. Those ground stations were located in the dusk sector during the period of the event, and longitudinally separated away from the auroral region by more than two hours of MLT. The initial movements of the H component were synchronized at all the stations. However, some phase shifts occurred independently among stations until the end of the first quarter- to half-period of the Pi 2. After the phase shift was completed, those phase differences among stations were retained to the end of the event. It was numerically confirmed that the phase differences among the stations, which were located in the dusk sector, can be explained by the differences in the time-of-flights (TOFs) of MHD waves that propagated from an epicenter of Pi 2, which is expected to be located on the magnetic-equatorial plane, to the ground stations through individual paths. The epicenter is assumed as a point wave source, and the propagation path is assumed as follows: At first fast mode propagated from the epicenter to the equatorial crossing point of the magnetic line of force which was anchored to a ground station. Then Alfven mode wave was excited there, and it propagated from there to the ground station along the field line. On the other hand, it is assumed that the initial movements of the H component were caused by the MHD waves that propagated in the following way: For a low-latitude station, fast mode wave propagated directly from the epicenter to the ground station radially. For the mid- and high-latitude stations, at first fast mode wave propagated from the epicenter to a low-altitude region above a ground station. Then Alfven mode wave was excited there, and it propagated from there to the ground. It is estimated that the TOFs of these two paths were almost the same, thus the initial movements of the Pi 2 were observed concurrently. It is possible to discuss this event using the analogy to 'primary wave (P-wave)' and 'secondary wave (S-wave)' seen in seismic waves: The initial movement of the H component corresponds to the P-wave, and the successive part of the main oscillations of the H component corresponds to the S-wave. The present study reports for the first time the evidence of Primary- and Secondary magnetoseismic waves associated with a Pi 2 magnetic pulsation, which was observed in the dusk sector and away from the auroral occurrence region. The present event provides important information for better understanding of the propagation mechanism of Pi 2 in the magnetosphere, especially concerning the propagation path and the mode conversion process.