論　説

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S-P時間を用いた再解析によって明らかになった1970年代の箱根群発震源域の特徴
―最近の群発震源域との比較―

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Features of Hypocental Area of Swarm Earthquakes in Hakone Volcano in 1970's Revealed by Re-Analysis Using S-P Data
―Comparison with Recent Activities―

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The Hot Springs Research Institute (HSRI) has developed seismic observation network in Hakone volcano since 1968. In the first decade of the observation by the HSRI, hypocenters were determined by using S-P times and the Omori equation and were confined in the Owakudani geo-thermal area. This is remarkable, because earthquakes are known to occur in an extended area in the Hakone caldera recently. In this paper, we try to clarify whether the past hypocenters are real. For the purpose we introduce a fitness value to estimate the most probable location of swarm activity based on the S-P times. First, we calculate synthetic S-P times from every grid point that covers the Hakone caldera with a spacing of 500 m for all observation sites. Then, Root Mean Square (RMS) between observed S-P times for each earthquake in a certain swarm activity and the synthetic S-P times is calculated for all the grid points. The fitness value given to grid points is defined as the summation of the inverse RMS for all earthquakes belonging to the swarm activity concerned. It is considered that the grid points with large fitness values exhibit the most probable area of the swarm activity. From the analysis we found that earthquakes in the period of 1970 s occurred in an extended region from Mt. Kintoki to Motohakone, not confined to the Owakudani area. Some of the swarms seem to have occurred near Lake Ashi. In conclusion, we think that hypocentral distribution of swarm earthquakes in the past is not much different from that in recent years and swarm activities in the Hakone caldera have occurred in a similar way at almost the same region since 1970 s.
Key words: Earthquake swarms, Hakone volcano, Historical earthquake distributions

1. はじめに

箱根火山は伊豆衝突帯の北部に位置し，直径10 kmほどのカルデラ構造をもつ活火山で，過去何度も，鳴動やがけくずれなど地表変動を伴う群発的な地震活動が発生したことが知られている（例えば，萬年，2003）．大森房吉は1917年の群発活動の際，箱根宮の下の富士屋ホテルに100倍微動計を置いて地震を観測し，箱根火山において初めて地震計データに基づく震源の推定を行った（温泉地学研究所，1992）．観測された群発地震のS-P時間の平均は0.7秒で，これから大森係数を6と仮定して震源距離を4.3 kmと求めている．1959年から60年にかけての群発地震の際には，東京大学地震研究所の水上教授らによる地震観測が行われた．中央火口丘を囲む8点に速度型地震計を設置し，紙送り10〜30 mm/sで波形の記録を行った．震源は大湧谷から早雲山付近の海抜0〜−4 km付近と推定されている（水上，1960）．このときに展開された観測網の一部は，神奈川県土木事務所に引き継がれた．その後，1966年に再び大規模な群発地震活動が発生し，翌年に温泉の顕著な昇温現象が観測されて，温泉と火山活動を総合的に研究することの重要性が認識

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