3-D assessment of geothermal resources based on standardized 250-m mesh-layer system: A case study for the Oita area, Japan

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1. Introduction: Regional geothermal resources assessment is important as a base of rational exploration, development, utilization and sustainment of the resources. Since 1950's, Geol. Surv. Japan, Japan Geotherm. Energy Assoc., NEDO among others have conducted the assessments for various purposes, by various methods, and using various kinds of data in Japan, but lacked in continuous effort. Geothermal Resources Research Group, GREEN, AIST, has been conducting 'Study on Geothermal Resources Assessment using GIS' (Shigeno and Sakaguchi, 2002), and trying development of the assessment in an integrated, continuable, multipurpose and open manner, using standardized common data formats including 3-D data. In this article, case-study results for the 'Oita' quadrangle map area (1:200,000 scale) are reported as a summary of the first phase of the study (Shigeno, 2005a, b).

2. Methods of data analysis: (1) At the first step, 2-D analysis for selecting promising areas has been conducted by calculating two integrated scores (parameter values) for thermal structures and reservoir structures (including formation and fracture types). Through the procedures, the data format of standard 250-m mesh numerical maps (320 * 320) for elevation by Geograph. Surv. Instit. has been commonly applied to editing and analyzing various kinds of open electric data (geology mesh and gravity-anomaly grid by Geol. Surv. Japan (1995, 2000), tables of fumaroles and hot-springs by Sakaguchi and Takahashi (2002) among others). Promising resource types (regional thermal conduction systems, Hot Dry Rocks, low-intermediate-high-temperature hydrothermal systems) for each mesh have been estimated by the above parameters, and summarized for the areas (Shigeno, 2005a).

(2) At the second step, simplified 3-D analysis has been conducted using 250-m interval layers from the surface to 5 km depth for each mesh (20 cells). Applying the results of the first step, 5-km depth temperature (XH C), bottom depth of the formation-type reservoir (YB km), and the effect of fracture-type reservoir (ZF) have been estimated. Simplified simulation based on the 1-D 'extended thermal conduction' model (Shigeno, 2000) for each mesh has been conducted using the above three parameter values, and equilibrium temperature, a hypothetical reservoir characteristic value, and resource types have been calculated for the whole area (320 * 320 * 20 cells). The above results have been summarized as tables classified for the depth and the surface environment (the relation to National Parks) (Shigeno, 2005b).

3. Results: Essential parts of the results will be disclosed at the Poster Session. Refer to Shigeno (2005a, b) for details. Fig. 1 shows distributions of estimated temperature and resource types of the 'Oita' area at 1, 2 and 3 km depths as one of the most important results by the 3-D analysis. In future, more integrated data editing, analysis and presentation will be conducted based on hierarchical mesh-layer systems and the essential information obtained by test-well drilling and others.

4. Summary: Resources assessments will need more long-term planning and conduction with much more cares for future expansion, efficiency and openness with accordance to progressing technological developments and social demands. For the purpose, constructing good electronic databases and endurable data operation system is very important. On the basis of the above results at the first stage, we will continue editing related data, improving the system, and disclosing the data and assessment results for everlasting geothermal resources development and sustainment (scoping optimal development of local areas including environmental protection and volcano hazard mitigation). The results of the first phase of this study will be published on CD-ROM including various edited and analyzed data and utility software in the near future.

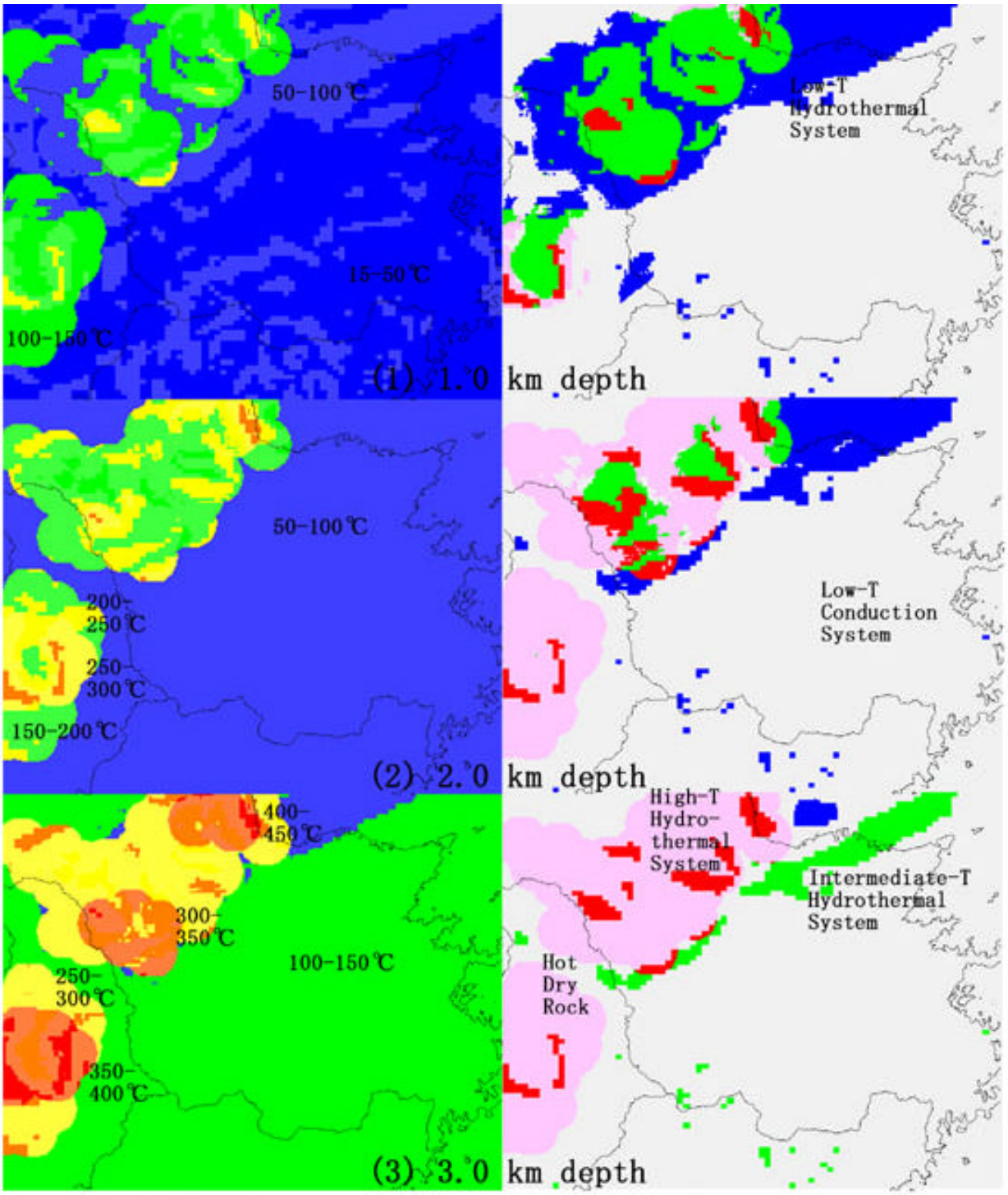

Fig.1 Distributions of estimated temperature and geothermal resources types for the 'Oita' area at 1, 2 and 3 km depths.