

## Geothermal Energy

## 地熱能

11.1 Physical Terms	11.1 物理名詞
<p>11.1.1 Terrestrial heat flow: geothermal flux: geothermal flux density The flow of heat traveling from the interior of the earth to the surface of the earth, in consequence of the higher temperatures prevailing in the interior arising from the natural decay of radioactive elements in the earth's crust and residual heat in the earth's formation. The mean terrestrial heat flow at the earth's surface amounts to approximately: 0.06J/ (m<sup>2</sup>.s) Note 1 HFU (Heat Flow Unit)=4.18×10<sup>-6</sup>J/(cm<sup>2</sup> s),giving a mean terrestrial heat flow of approximately 1.5 HFU.</p>	<p>11.1.1 地殼熱流量；地熱通量；地熱通量密度 指從地球內部流傳到地表之熱流量，此乃因地殼中放射性元素之天然衰變以及地球生成時，殘餘熱等產生之高溫所造成。地球表面之平均地殼熱流量約 0.06J/ (m<sup>2</sup>.s) (註) 1 HFU (熱流單位) =4.18×10<sup>-6</sup>J/ (cm<sup>2</sup>.s) 之故，平均地殼熱流量約 1.5HFU。</p>
<p>11.1.2 Geothermal gradient : geothermal temperature gradient The increase in temperature per unit depth through the crust and upper layers of the earth's mantle in the direction of the centre of the earth. The average temperature gradient near the surface is approximately: 0.03°K/m or 30°K/km.</p>	<p>11.1.2 地溫梯度；地熱溫度梯度 在指向地心的方向上經地殼及地單上部，每單位深度之溫度增加。近地表之平均溫度梯度約 0.03°K/m 或 30°K/km</p>
<p>11.1.3 Geothermal depth gradient The reciprocal of geothermal temperature gradient. The mean value for geothermal depth gradient near the surface is approximately: 33m/°k</p>	<p>11.1.3 地熱深度梯度 地熱溫度梯度之倒數，近地表之平均地熱深度梯度約 33m/°K</p>
<p>11.1.4 Geothermal potential The quantity of heat that can be released by cooling a given volume component of the earth's crust at a known location down to a specified temperature (e.g. 100°C). Note This term is not to be confused with geothermal energy potential.</p>	<p>11.1.4 地熱潛能 在一已知地點，將地殼中一定體積之部份冷卻至一特定溫度（譬如 100°C）所釋放出之熱量。 (註) 此語不可與地熱能潛力混淆。</p>

<p>11.1.5 Geothermal anomaly conspicuous deviation of geothermal temperature gradient or heat flow from average values.</p> <p>11.1.6 Low-temperature area: semi-thermal area Area of geothermal potential with temperature gradients less than 100°K/km.</p> <p>11.1.7 High temperature area; hyper-thermal area Area of geothermal potential with temperature gradients greater than 100°K/km. Note The classification of areas as defined in 11.1.6 and 11.1.7 is not recognized in some countries, while in others the dividing line is taken as 80°K/km.</p>	<p>11.1.5 地熱異常 地熱溫度梯度或熱流量與平均值有顯著偏差者。</p> <p>11.1.6 低溫區域;微熱區域 溫度梯度低於 100°K/km 之具有地熱潛能區域。</p> <p>11.1.7 高溫區域;過熱區域 溫度梯度高於 100°K/km 之具有地熱潛能區域。 (註) 11.1.6 與 11.1.7 所定之區域分類在有些國家並不被認定,而有些國家以 80°K/km 為區分線。</p>
<p>11.2 Geological Terms</p>	<p>11.2 地質名詞</p>
<p>11.2.1 Magma Mass of molten rock within the earth's crust.</p> <p>11.2.2 Magma-chamber An inclusion of magma in the earth's crust.</p> <p>11.2.3 Lava Magma that has flowed to the surface of the earth, at first in the molten state but becoming solidified after eruption from a vent (effusive rock, eruptive rock). The rock ranges from basic to acid; when solidified it is generally vesicular due to the escape of gases during solidification and sometimes has a glassy appearance due to rapid cooling.</p> <p>11.2.4 Pluton Hot rock at varying depths. In cases of geothermal anomaly this rock may be relatively near to the surface.</p> <p>11.2.5 Fumarole Hot spring or pool from which gas and steam from active volcanoes and from streams of cooling magma are vented at temperatures above 100°C.</p> <p>11.2.6 Solfatara Hot spring or pool venting sulphur-rich gases.</p> <p>11.2.7 Geyser Hot spring that ejects steam and</p>	<p>11.2.1 岩漿 地殼內融熔岩石。</p> <p>11.2.2 岩漿室(穴) 地殼中岩漿之包體。</p> <p>11.2.3 火山岩 流到地表之岩漿(溢流岩、噴出岩),從火山口噴出後最初為融熔狀態而後逐漸固化。岩石種類從鹼性至酸性;固化之際因氣體逸散,故常呈多孔性,偶因急速冷卻而呈玻璃質。</p> <p>11.2.4 深成岩 在不同深度存在之熱岩體。地熱異常之情況下此岩體可能較接近地表。</p> <p>11.2.5 噴氣孔 指噴出高於 100°C 之氣體與蒸汽之溫泉或池,該氣體與蒸汽來自活火山及冷卻之岩流。</p> <p>11.2.6 硫氣孔 指噴出含有高硫份氣體之溫泉或池。</p> <p>11.2.7 間歇泉 指噴出蒸汽與熱水之溫泉;許</p>

<p>hot water; many geysers erupt at regular intervals of time. (See also 11.3.2)</p> <p>11.2.8 Batholith An extensive formation of plutonic rock mostly granitic, that has intruded while in the molten state into the earth's crust and has solidified there, without reaching the earth's surface. Batholith is a term defining a particular manifestation of pluton.(See 11.2.4.)</p> <p>11.2.9 Hot dry rock Rock that for the depth at which it lies is at higher than average temperatures (geothermal anomaly)and which due to lack of porosity or lack of fissures does not contain water or steam inclusions.</p> <p>11.2.10 Aquifer Formation of permeable, water-bearing rock.</p>	<p>多間歇泉均在一定之時間間隔下噴出。 (參考 11.3.2)</p> <p>11.2.8 岩磐 指深成岩所形成廣大地層，多為花崗岩質，該深成岩在融熔狀態下侵入地殼，在未抵達地表前冷凝而成。岩磐乃深成岩之特殊指標。</p> <p>11.2.9 熱乾岩 指地下具有高於平均溫度（地熱異常）之岩石，該岩因缺乏孔隙或裂縫而不包含水蒸汽。</p> <p>11.2.10 蓄水層 可滲透且含水之岩層。</p>
<p>11.3 Evaluation Criteria, Occurrence and Deposits of Geothermal Energy</p>	<p>11.3 地熱能之評估基準、產狀及礦床</p>
<p>11.3.1 Geothermal fluid The dry steam, wet steam or hot water, together with dissolved and entrained substances, conveyed or flowing out of the earth's crust.</p> <p>11.3.2 Geothermal steam field: geothermal steam reservoir The occurrence of steam in underground structures that has been generated as a result of geothermal anomalies but which, due to enclosing strata, cannot escape or can only escape in negligible quantities.(See also 11.2.7).</p> <p>11.3.3 Geothermal hot water field: geothermal hot water reservoir The occurrence of water in an aquifer that is heated by the surroundings and that is maintained under a hydrostatic pressure greater than the saturation pressure so that no steam phase forms.</p> <p>11.3.4 Thermal waters: geothermal warm water</p>	<p>11.3.1 地熱流體 指抽出或流出地殼之乾蒸汽、濕蒸汽或熱水以及溶解與附隨之物質。</p> <p>11.3.2 地熱蒸汽田；地熱蒸汽貯集層 在地下構造中由於蒸汽之存在導致產生地熱異常。該蒸汽因地層封閉之故無法或僅有微量能够逸散。</p> <p>11.3.3 地熱熱水田；地熱熱水貯集層 蓄水層中存在之水，該水受周圍環境加熱，在某一高於飽和壓力之靜水壓下得以保持液態而無汽態形成。</p> <p>11.3.4 熱水；地熱溫水貯集層 在某低於飽和</p>

<p>reservoir The occurrence in geological structures of warm and hot water at a temperature below that of saturated steam at the prevailing pressure.</p> <p>11.3.5 Water inclusions: geopressurised system Water locked in between layers of rock and maintained under lithostatic pressure.</p> <p>11.3.6 Hot lava Geologically recent lava-fields with high rock temperatures, i.e. up to approximately 1200°C.</p>	<p>蒸汽溫度與壓力下存在於地質構造中之溫水及熱水。</p> <p>11.3.5 水包體；地壓系統 被封閉於岩層之中並保持於靜岩壓下之水。</p> <p>11.3.6 熱熔岩 地質時間上最近之熔岩體，該岩具有可高達 1200°C 之高溫。</p>
<h3>11.4 Technology</h3>	<h3>11.4 術語</h3>
<p>11.4.1 Geothermal power station/plant: geothermal heat station/plant A geothermal power station or plant converts geothermal energy into electrical energy. A geothermal heat station or plant makes geothermal energy available as heat only, e.g. for space heating and process heating.</p> <p>Note The temperature of the geothermal fluid determines its potential application, namely:</p> <ul style="list-style-type: none"> <li>up to 80°C – space heating,</li> <li>up to 150°C – process heating and/or electricity generation,</li> <li>over 150°C – electricity generation.</li> </ul> <p>11.4.2 Single bore-hole technology The simplest system for the exploitation of geothermal energy, in which naturally occurring geothermal fluids are produced from a single bore hole and, after extraction of the available energy, the fluids are discarded at the surface. (See note to 11.4.4.)</p> <p>11.4.3 Single bore-hole (concentric pipe) technology; down-hole heat-exchanger technology Process for exploiting the potential of geothermal energy with the use of a single bore hole in which the bore hole is fitted with twin pipes, generally</p>	<p>11.4.1 地熱發電站／廠；地熱供熱站／廠 地熱發電站或發電廠可將地熱能轉換成電能。地熱供熱站或廠僅提供地熱之熱能，譬如用做暖房加熱與工業製程用熱。 註：地熱流體之溫度決定其可能的應用方式，亦即：</p> <ul style="list-style-type: none"> <li>—80°C 以下—暖房加熱。</li> <li>—150°C 以下—工業製程加熱以及／或者發電。</li> <li>—150°C 以上—發電。</li> </ul> <p>11.4.2 單鑽孔技術 開發地熱能最簡單之系統，自然產生之地熱流體可從一單鑽孔中產出，而在萃取其可用之能後，該流體被排放於地表。（參考 11.4.4 之註）</p> <p>11.4.3 單鑽孔（同心管）技術；井下熱交換器技術 利用一單鑽孔來開發地熱能之方法，該孔裝配雙管，一般為同心管，熱交換介質（水）從內管被注入地熱岩層，然後從外管回到地表；井下熱交換器技術為密閉系統。（參考 11.4.4 之註）</p>

<p>concentrically arranged, the heat-transfer medium (water) being fed to the geothermal rock formation through the inner pipe and returned to the surface through the outer pipe; in the case of the down-hole heat-exchanger technology, the system is a closed one. (See note to 11.4.4.)</p>	
<p>11.4.4 Dual (multi) bore-hole technology Process for exploiting the potential of geothermal energy with the use of two (or more) bore holes, in which the cooled heat-transfer medium (water) is returned to the geothermal rock formation through at least one of the bore holes.</p> <p>Note The number and arrangement of bore holes employed are dependent on the temperature and pressure conditions and on the chemical composition of the geothermal fluid serving as heat-transfer medium.</p>	<p>11.4.4 雙(多)鑽孔技術 利用兩口(或多口)鑽孔來開發地熱能的方法,此法中已冷卻的熱交換介質(水)透過一口以上之鑽井被注回地熱岩層。</p> <p>(註)鑽孔之數目與安排由做為熱傳介質之地熱流體之溫度與壓力條件以及其化學成分決定。</p>
<p>11.4.5 Hot rock technology A process of extracting useful geothermal energy by the injection of a heat-exchange medium (water) into hot dry rock.</p>	<p>11.4.5 熱岩技術 將一種熱交換介質(水)注入熱乾岩以萃取有用的地熱能之方法。</p>
<p>11.4.6 Hydraulic fracturing The fracturing of rock formations by hydraulic pressure, sometimes accompanied by the injection of propping material (e.g. sand) to hold open the hydraulically induced fracture. (See also 11.5.2 and 5.7.5.)</p>	<p>11.4.6 液裂技術 利用液壓使岩層破裂之技術,有時伴隨支撐材料(譬如砂)之注入以保持液壓所導致裂縫之打開。(參考 11.5.2 與 5.7.5)</p>
<p>11.5 Additional Terms</p>	<p>11.5 增訂名詞</p>
<p>11.5.1 Impurities content of geothermal fluid Substances in chemically combined, dissolved or undissolved state that are contained in the geothermal fluid.</p> <p>Note The impurities content of the geothermal fluid is a factor that may seriously affect the economics of exploiting a particular geothermal field. Fluids with a</p>	<p>11.5.1 地熱流體雜質 地熱流體中化學組合,溶解成不溶解狀態之物質。</p> <p>(註)地熱流體雜質在開發一特殊地熱田時為可嚴重影響其經濟性之一因素。含有大量礦物之流體有特殊排放之危險,並且對商業性電廠產生腐蝕影響。</p>

<p>high minerals content can involve special effluent risks and have corrosive effects on commercial plant. (See also 11.5.3.)</p> <p>11.5.2 Enhancement of permeability Process aimed at improving flow conditions for the heat-transfer medium. (See, for example, 11.4.6 and 5.7.5.)</p> <p>11.5.3 Re-injection The return of water to an aquifer after the extraction of its thermal energy, for prevention of environmental pollution due to the mineral content of the water and/or for maintaining stable underground conditions of pressure and supply. Water from another source may also be injected for the latter purpose.</p> <p>11.5.4 Toxic/corrosive gases Naturally occurring gases that may be associated with the geothermal fluid and that have corrosive or toxic characteristics, e.g. H<sub>2</sub>S, HCl, HF, NH<sub>3</sub>, etc.</p> <p>11.5.5 Salinity Dissolved salt content of a fluid, often a characteristic of geothermal fluids.</p> <p>11.5.6 Hydrogeological flow the movement of underground waters. Geothermal flow arise as a result of pressure and/or temperature differences and they produce convective heat transfer.</p>	<p>11.5.2 滲透率之增強法 目的為改善熱交換介質流動條件之方法。(參考 11.4.6 與 5.7.5)</p> <p>11.5.3 回注 將萃取過熱能之水注回蓄水層謂之，目的在於防止水中礦物產生之環境污染以及／或者保持穩定的地下壓力條件與供應。其他來源之水亦可注入以保持穩定之供給。</p> <p>11.5.4 有毒／腐蝕性氣體 可能與地熱流體相伴而自然發生之氣體，該氣體具有腐蝕性或毒性，如硫化氫、氯化氫、氟化氫、氫等。</p> <p>11.5.5 鹽度 溶解於流體中之鹽份，常為地熱流體特性之一。</p> <p>11.5.6 水文地質流 地下水之流動。地熱向上流動乃因壓力以及／或者溫度差而產生，同時該地熱體流製造對流之熱傳。</p>
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