The Geothermal Information Platform (GIP)

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ABSTRACT

In a century of history, geothermal exploitation for power production and direct uses of geothermal heat has provided a large knowledge, and also underlined the different aspects characterising geothermal world. The exploitation of geothermal energy not only requires the knowledge of underground conditions and of different technologies, but also other relevant items such as regulatory, economical and social. A huge variety of information, such as research roadmap, training, energy demand, market request, needs and gaps, draws a complex picture.

Advanced Business Intelligence (BI) tools, advanced catalogue software, advanced webGIS tools, platform for managing different users and roles, advanced and performance Relational Database Management System (RDBMS), are well known and largely used in geothermal but none of these is completely integrated.

GIP is thought as a unique tool that can ensure a 360° data browsing (e.g., browsing from a catalogue to a document, from a document to a tabled info or spatial data) and allowing a deep survey into the geothermal knowledge.

1. INTRODUCTION

Nowadays, the need to manage a large quantity of data related to different fields and stored in different ways requires, beside a structured data organisation, information analyses and recovery systems able to respond in a quick and efficient way. Thanks to the technological evolution of tools for data management system (DMS), the geothermal knowledge inherited and managed with time is now operated by information platforms allowing the immediate data integration and analysis.

In the Italian Geothermal Information Platform (GIP) the structured information are archived within a Relational Database Management System (RDBMS) (Codd 1970), while those unstructured are managed by File Systems (FS). FS data are catalogued and indexed in order to speed data search and recovery processes. Data cataloguing for thematic areas allows the access to archived data (Fig.1). By using tagged documents it is possible to retrieve correlated data, belonging to different thematic areas, following a social network model (Fig. 2).

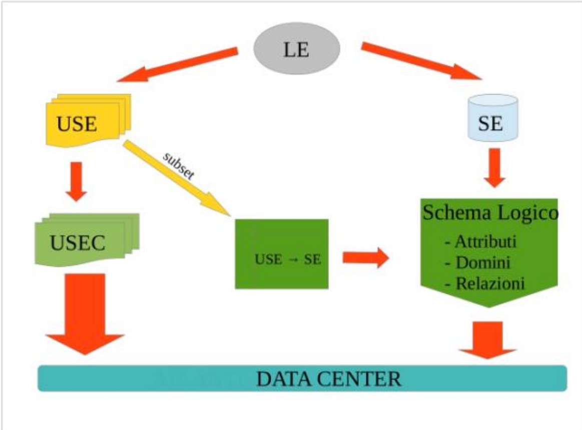

Figure 1: Conceptual schema of structured and un-structured data management: LE=List of Entity, SE=Structured Entity, USE=Un-Structured Entity, and USEC=Un-Structured Entity Catalogued.

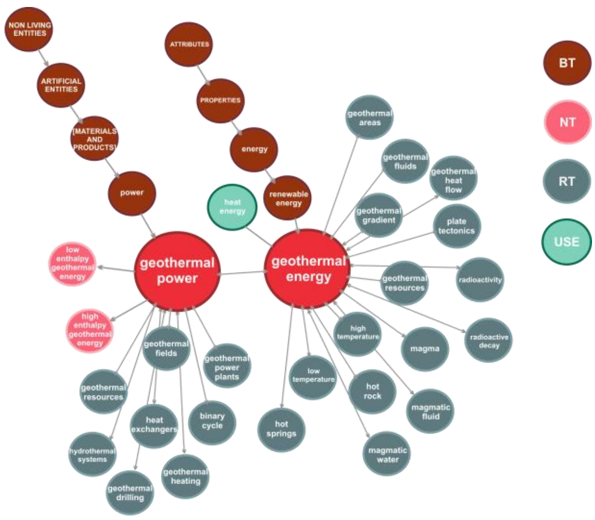

Figure 2: Graph representing geothermal thematic elements.

2. GIP FUNCTIONALITIES

The GIP platform, accessible through a web site, contains an heterogeneous data set and various functions depending on the level of permission granted by the system administrator to different users. In GIP, the access to underground data stored in the database, e.g., temperature, stratigraphy, reservoir hydraulic and fluid features, is managed by a business intelligence system. Data are provided in form of graphs, reports and maps, which are defined *a priori* in order to facilitate access and analysis in an aggregated way.

A webGIS tool to provide maps is also included in GIP application, and allows users to explore the spatial information, to query the object belonging to the maps and to view the iconographical documents connected to map's item. Spatial GIP capabilities can also deal with the main internet map services such as WMS and WFS, to allow the use of spatial data outside the geothermal platform.

GIP embeds a virtual library that manages the access to reports and papers, allowing the research by search fields (e.g., author name, keywords, journal, date) and by geographic location referred to each paper. Papers covered by copyrights are accessible only to authorised users.

All un-structured documents, documents regulating geothermal exploitation (laws, directives, authorisation document forms), general information, public documents related to exploration or concession licenses, geothermal employment data, training courses lists and related document (data, links, presentations, training manuals) are catalogued and stored in a FS and therefore managed by a DMS.

3. GIP APPLICATION

The GIP acts as a prototype of data center for VIGOR and ATLANTE projects, where geothermal assessment and mapping of suitability for different geothermal uses are the main targets.

In VIGOR project the data stored are retrieved in order to assess the resource below 500 m depth, therefore to identify and locate the reservoir, estimate the amount of heat in place and eventually the energy produced on the base of the resource and of the geothermal application (e.g., power production by binary plant, or various types of direct use). A three dimensional model discretised into a regular grid spaced 1000 m laterally and 100 m in depth. For each cell the Heat In Place and Technical Potential are calculated (Van Wees et al. 2012) to extract the grid maps representing the most suitable place for a specific kind of application.

VIGOR data center has the core into the project web site where the user can retrieve the outcome documents (Fig. 3), and the authorised users can log in the private part of the platform to view and download sensible documents, to access the spatial catalogue, (Fig. 4), either virtual (Fig. 5) or geo library (Fig. 6). WebGIS link is published within the product web page. The query tool of webGIS (Fig. 7) allows to view the related information data stored in VIGOR RDBMS, by clicking on an item on the maps.

Figure 3: VIGOR project web site: products page.

Figure 4: VIGOR project spatial data catalogue.

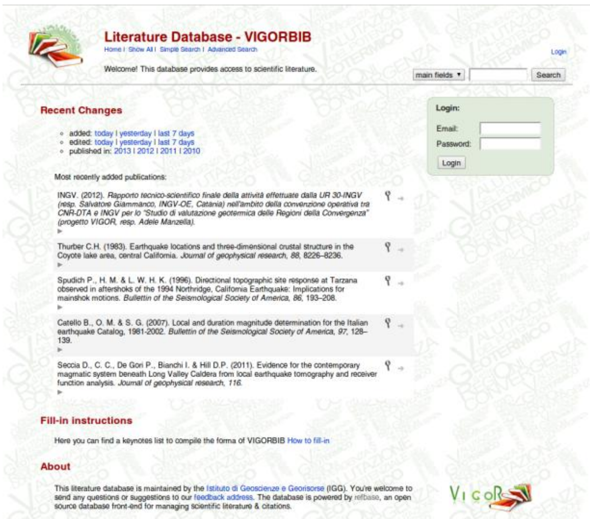

Figure 5: VIGOR project virtual library.

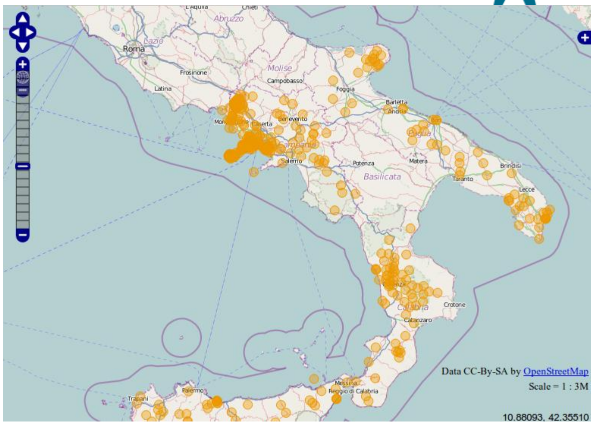

Figure 6: VIGOR project geo-virtual library.

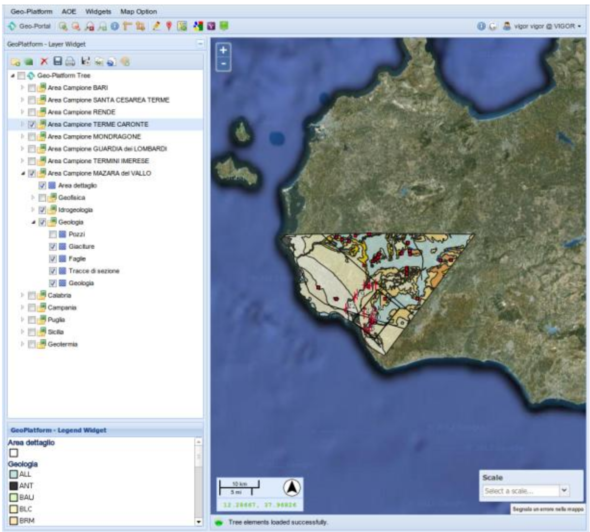

Figure 7: VIGOR project webGIS tool.

The ATLANTE project is producing a set of regional favourability maps for power production from conventional/hydrothermal geothermal systems, enhanced geothermal system (EGS), geopressurized system and unconventional systems (supersaline brine, supercritical condition, magma), between 0 and 10 km depth. The favourability is calculated by combining some important GIS layers belonging to the GIP (Graeme F. Bonham-Carter 1994).

The Atlante data center is still in progress and will be released within summer 2013.

4. CONCLUSIONS

The GIP is a prototype developed by CNR-IGG for Italy, and future development regarding both functions and content, will include also economic and social aspects.

GIP, by ensuring a wide data access and analysis and by guaranteeing data interoperability, can be considered as National standard.

At European level, a European GIP (EGIP), where the information coming from each National GIP are collected and updated, could be realistically developed within the next future. In this context each country should provide services and information following a precise protocol. The protocol should define data content and format (e.g. typology, measuring unit), ensuring a complete data harmonisation among European countries. The protocol definition could contribute to the implementation of the INSPIRE data specifications.

REFERENCES

Codd, E.F.: A relational model of data for large shared data banks. Communications of the Association of Computing Machinery 13 (6), (1970), 377-387.

Geonetwork reference. http://geonetwork-opensource.org/, [accessed 01 November 2010]

GeoSDI reference. http://www.geosdi.org/index.php/it/ , [accessed 01 January 2011]

Geoserver reference. http://geoserver.org/display/GEOS/Welcome, [accessed 01 January 2011]

Graeme F. Bonham-Carter: Geographic Information Systems for Geoscientists, Modeling with GIS - Pergamon/Elsevier Science Publications, (1994), ISBN: 0-08-042420-1.

INSPIRE European Directives reference. http://inspire.jrc.ec.europa.eu/, [accessed 01 January 2012]

Open Geospatial Consortium (OGC) reference. http://www.opengeospatial.org/, [accessed 01 January 2011]

PostGIS reference. http://postgis.refractions.net/documentation/manual-1.5/ , [accessed 01 February 2010]

PostGIS web-site. http://postgis.refractions.net/ , [accessed 01 February 2010]

PostgreSQL references. http://www.postgresql.org/docs/8.3/interactive/index.html , [accessed 01 February 2010]

PostgreSQL web-site. http://www.postgresql.org/ , [accessed 01 February 2010]

Refbase references. http://www.refbase.net/index.php/Web_Reference_Database , [accessed 01 February 2011]

SpagoBI documentation. http://spagobi-info.eng.it/SpagoBISiteITA/target/docs/index.html, [accessed 12 April 2010]

SpagoBI web-site. http://www.spagobiworld.org/xwiki/bin/view/SpagoBI/ , [accessed 05 April 2010]

SpagoBI wiki, the place where you can find useful information on SpagoBI. http://wiki.spagobi.org/xwiki/bin/view/Main, [accessed 15 April 2010]

Van Wees, J.D., Kronimus, A., Van Putten, M., Pluymaekers, M., Mijnlieff, H., Hoof, P.V., Obdam, A., Kramers, L.: Geothermal aquifer performance assessment for direct heat production. Methodology and application to Rotliegend aquifers. Netherlands Journal of Geosciences, (2012), ISSN0016-7746.

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