Geothermal energy studies in Venetian Prealps (Valle del Chiampo area, Vicenza-NE Italy)

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The PhD project aims to provide the conceptual geothermal model in the North of Vicenza region (Italy), up to 5 km depth. Currently there is no geothermal models focused on full geothermal energy projects in Northern part of Italy and this research would boost the overall knowledge on this specific topic. Conventionally, in Italy geothermal energy power projects take place only on young volcanic areas, where hydrothermal fluids and high geothermal gradients occur. In the current project, the geothermal energy exploitation is simple connected to sedimentary sequences, where the temperature might increase according to the standard geothermal gradient and concerned by a deep hydrogeological circulation and a hydro structural favorable situation. These kind of geothermal projects are going to be more and more common in Central and Northern Europe areas. The Ph.D. research would also take an advantage on the geothermal exploration program that is going to start in this area. Indeed, this research is part of a project that plans to exploit geothermal energy in the Valle del Chiampo area, according to the geothermal explorations outcomes.

Importance, impact and social consequences of the proposed research:
The proposed research would allow a significant improvement of the scientific knowledge regarding the geological, geophysical, hydrogeological, geochemical and – of course – geothermal aspects of this area. Moreover, the possible impact of the exploitation of geothermal energy sources in this area would play a key role in sustainable development. After the electric power exploitation, local industrial processes and a district heating project are planned by using the waste heat of geothermal fluids. Reduction of carbon dioxide emissions and district heating should also part of the advantages of the geothermal energy exploitation package.

The research activities are planned in the three years of the Phd course as follows:
First year: preliminary collection of the existing information: in this area existing data bases of geological and hydrological data might be already available. These have usually been gathered for other purposes but may very well be useful for guiding early geothermal surveying and exploration. Initially this study should start by collecting previous borehole data from oil and gas exploration (Eni database) such as geophysical surveys, hydrogeological data, geochemical analysis on springs and water wells.
Remote sensing analyses, by means of aerial and satellite images, and filed geological survey will compose a significant role in preliminary surveying for geothermal resources, especially regarding the geostructural features.

Second year: supporting to plan the field research activities: several field activities will take place in order to support the investigations conducted by a specialized company, regarding geophysical surveys (magnetotelluric methods, gravimetry, etc.) and geochemical (geothermometers and isotopes). Moreover, the Geoscience Department's laboratories allow the analysis of physical, mineralogical, petrographic and thermal parameters on rock collected samples. Exploration may start off looking at a wide area level and, as more data is gleaned, focuses down to a more localized analysis. Evaluation of general and specific potential environmental impact of local geothermal uses will be taken in to account in the phd program.
In the second year is planned a stay lasting at least 3 months of study abroad at one of the international project partners. Gathering the geothermal exploration data should drive towards the development of a 3D preliminary conceptual geological model, by mean of a 3D geological software (Tough2, Petrel, already held by the research group), where all information might be integrated, compared and interpreted. This phase will represent the inner core of the Phd activity.

Third year: during the last year of Phd activity, the conceptual geological model will be completed and improved in order to develop a preliminary geothermal model: the analysis of the 3D geological model should support the definition of the main geothermal parameters, like thermal gradient and temperature at depth, reservoir volume, expected pressure conditions and general enthalpy assessment. These estimated data should support the Montecarlo heat calculations and it is preparatory and guidance to the next stage of realization of exploration and production wells.

According to the overall workplan and the geothermal exploration outcomes, the research activity could be continued, analysing the results of the first planned geothermal exploration well.

International cooperation and partnership:
Several activities with international geothermal universities are considered in Germany, where a tight partnership is already ongoing with Prof. David Bertermann of GeoZentrum Nordbayern / GeoCentre of Northern Bavaria Friedrich-Alexander-Universität Erlangen-Nürnberg). Additional activities may be planned in New Zealand at the GNS Science and with Prof. Malcolm Grant (the most worldwide expert on Geothermal Engineering Reservoir topics). New advanced gas geochemical explorations (MMR, Mantle Magmatic Radiogenic sources) with the support of Prof. Eric J. Klingel staff of New Mexico University can be also possible. Regarding geochemical studies, our research group is also in contact with Dr. Jill Haizlip of Geologica and the Stanford University Geothermal group. Finally, some aspects of the thesis may be supported by Turkish colleagues (Izmir University) and Chile ones (Prof. Diaz of University of Santiago). A special partnership will be agreed with the National Research Council (Institute of Geosciences and Earth Resources) regarding groundwater isotope analyses and geological-structural studies, specially voted to geothermal exploration. Other researchers involved in the Phd project are: Prof. Raffaele Sassi, Prof. Giorgio Cassiani

This study would take place and supported by the GEOTAMO project (UNIPD, Dept. of Geoscience), which is going to start soon.

The research activity of this Ph.D. is fully founded by the GEOTAMO project, which is already approved by the Department of Geosciences; moreover, the private company of the GEOTAMO project is going to fully fund the field surveys. Finally, thermal, mineralogical and petro-physical measurements on rock samples are funded within the UE Cheap GSHPs project. The ex-60% grants would cover eventual additional costs.