INFORMATION ABOUT THE GEOTHERMAL ENERGY INVESTIGATION AND USAGE PROJECTS IN LATVIA (UPDATE REPORT '94)

Edvin Eihmanis

State Company Geothcrma of Latvia
2 Perses Str. LV 1442. Riga, Latvia

KEY WORDS: Latvia, Aquifers, Heat-in-place

ABSTRACT

General investigations of deep reservoir geology were started in the 1970's, howevor these were not carried out systematically.

A regular geothermal resource data base has been established since 1992, mainly in the framework of the Baltic Geothermal Energy Project.

This article presents a shon review of Latvian geothermal resources and their location, as well as a planned geothermal energy projects.

GEOTHERMAL AQUIFER ZONES

Geothermal aquifer zones of primary interest are in the Middle Cambrian Deimena Formation (the Cm2dm unit) and in the Lower Devonian Kemeri Formation (the D1km unit). Their lithologic characteristics are as follows:

Cm2dm: Sandstone, light to dark gray, quartzitic with interbeds of micaceous-quartzitic siltstone.

D1km: Sandstone. variegated, feldsparquartz, micaceous, subordinate siltstone and thin interlayers of clay.

Secondary objective zones may furthermore exist in the sections located above and below the D1km unit as well as in the Cambrian section underlying the Cm2dm unit.

PETROPHYSICAL REVIEW

At present the data base contains a suite of data from 23 selected wells distributed evenly throughout the area of investigation.

Depth and thickness of aquifer.

Average values as well as ranges with regard to the subsea depths and thicknesses of the Cm2dm and D1km aquifer units within the area were assessed as based on the Data Base and are shown k1ow (Table 1).

Maximum Cambrian thickness corresponding to 220 metres appears in the town Liepaja area located on the west coast.

Table 1 - DEPTH AND THICKNESS OF AQUIFER UNITS

	Depth,m(MSL)		Thickness,m	
	Range	Average	Range	Average
D1km	450-1,100	71	90-175	115
Cm2dm	1,100-2,000	1.55	40-200	90

Aquifer temperature.

Available data gives an average gradient of aproximately 3.2 °C/100 m for the D1km Formation and 4.2 °C/100 m for the Cm2dm Formation.

Comparing gradients at a depth of 1,000 m (MSL) displays a gradient of 4.4 °C/100 m for the D1km Formation and 2.8 °C/100 m for the Cm2dm Formation. Fig. 1 shows the Cambrian aquifer isothermal map with temperatures above 25 °C.

Aquifer transmissivity.

Average transmissivities values with regard to the Devonian aquifer zone are 110 Darcymetres, for the Cambrian zone considerably lower - 50 Darcymeues. Superior conditions in the Cambrian appears to be located in the Liepaja and the larger Riga-Dobele-Eleja-Iecava areas of western and south-central Latvia respectively, also within the thermal regime of 25-60 °C.

Geothermal Water Composition,

Water analyses are available for selected wells for the early Devonian and Cambrian Formations. The Devonian samples generally have salinities between 8-40 g/l with peaks up to 100 g/l. The Cambrian samples display less relative variation with values in the range 100-130 g/l.

The water analyses reveal the presence of predominantly sodium-calcium chloride solutions with subordinate presence of potassium and magnesium. None of the analyses indicate the

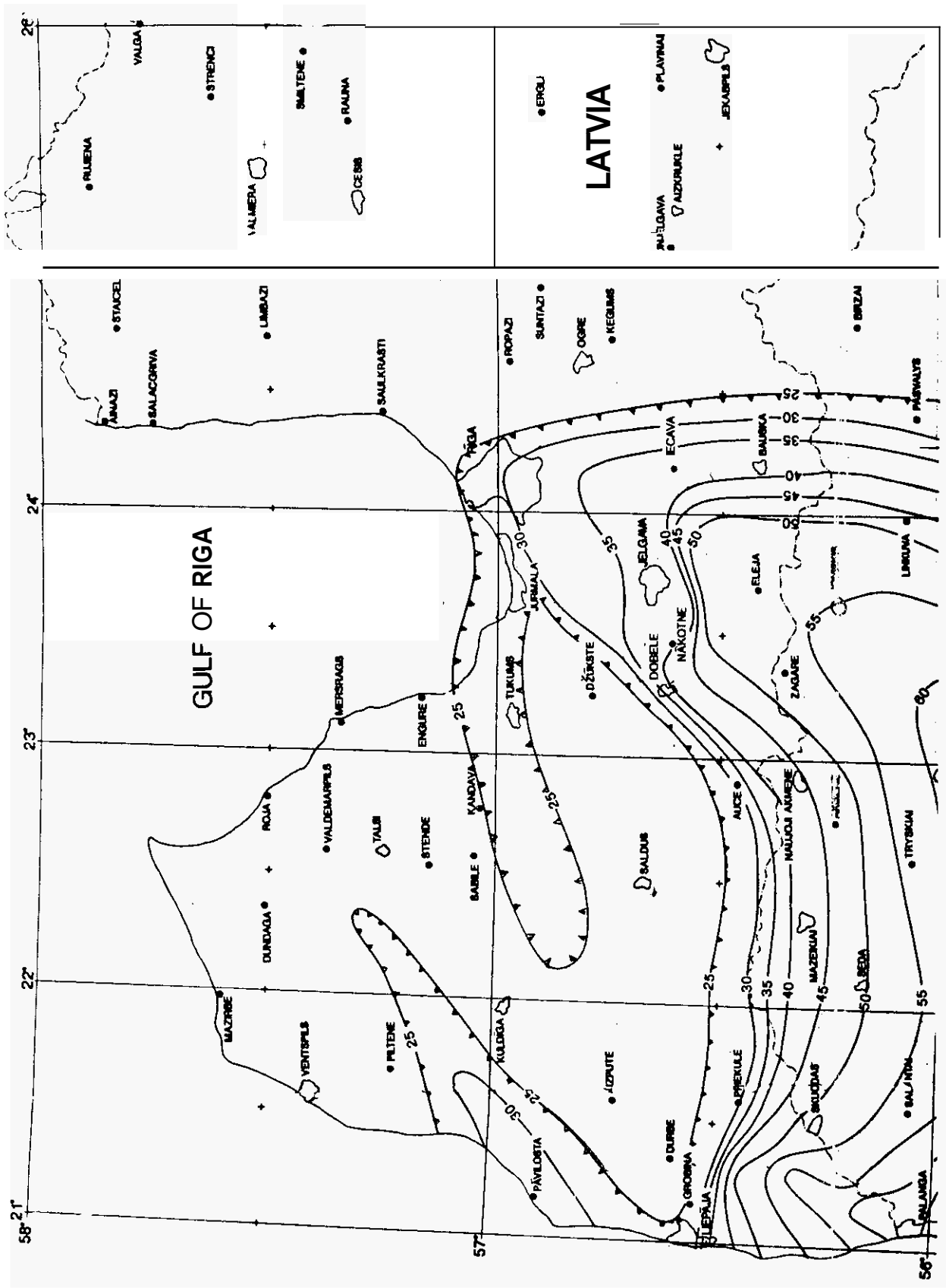

Figure 1: Cambrian aquifer isothermal map (Baltic geothermal energy project): contour interval 5 °C

presence of carbonate ions.
The waters are barren of sulphur compounds other than sulphate ions. Altough small amounts of bromide contents were found in the Cambrian waters it is believed that the waters can be regarded as non aggressive.

GEOTHERMAL ENERGY RESOURCES
The surface heat flow density values in the area of geothermal zone are in the range **40-70** mW/m^2. The geothermal heat energy potential was assessed in terms of regional geothermal heat resources (heat-in-place) and well head resources in accordance with recognised procedures for uansformation of hydro-geothermal data into energy resources, i. e. basically **as** recommended by the Commission of the European Union.
Technical and economic geothermal heat-in-place (HIP) were calculated based on assumed heat retrieval from the geothermal waters down to 7.5 °C (mean surface temperature) and 15 °C respectively. Well head resources were only calculated for the selected urban areas investigated.

Heat-in place (HIP).
The gross aquifer rock volume with regard to the aquifer zones of interest was established through planimetring of the relevant area versus thickness plots **as** based on related isopach maps. Average peuophysical parameters were applied and the net aquifer rock and geothermal water volumes were calculated. The specific heat capacity values for rock matrix and water were assessed and the HIP (geothermal resource) was calculated. The aquifer rock matrix of both the Cambrian and Devonian aquifer zones have heat conductivity about **2.5** W/m/°C. Specific heat capacities of the Devonian and Cambrian geothermal waters vary between **3.9 - 4.1** MJ/m^3/°C, basically due to the variance in the salinity of the aquifer waters **(50-180** g/l for the geothermal waters resources). Table **2** shows the results of this exercise.

Geothermal well head resources (WHR).
We can determinate the boundaries of two geothermal potential areas:
Eleja - in central part of Latvia and
Liepaja - in south-western part of Latvia.
The well head resources were calculated for the urban areas investigated based **on** individually assessed technical HIP. The area underlying the HIP calculation for an urban area was determined **as** the city area plus the area located three kilometres outside the city limits. The results of this exercise reveals a collective well head resource corresponding to approximately **840** Petajoule.

TABLE **2** - GEOTHEKMAL HEAT-IN-PLACE

PARAMETEK	**Dlkm**	Cm2dm
Geothermal area **25** °C,km^2	**1,000**	**12,000**
Gross aquifer rock volume 10^9m^3	**150**	**1,260**
Net aquifer rock volume 10^9m^3	**99**	**604**
Water volume 10^9m^3	**22**	**85**
Average aquifer temperature °C	**24**	**44**
Technical heat resource 10^{18}J	**5.4**	**46.4**
Economical heat resource 10^{18}J	**3.4**	**35.4**

UTILIZATION PROJECTS
Based on the aquifer zone evalutions and the investigations of the existing district heating networks within the urban areas, the establishment of geothermal demonstration plants is planned in Liepaja. located in the southern town area at coordinates 56°29'54"N and 20°59'25"E.
The heat supply from the this plant **as** planned would correspond to **420** TJ/year. The heat production costs, including costs while repaying a **25** year plant loan , are calculated to average **3** USD/GJ.

ACNOWLEDGEMENTS
The geothermal energy investigation in Latvia was made possible in pursuance of financial support provided through Danish Environmental Protection Agency and for which the Geothermaof Latvia wish to express gratitude.

REFERENCES
Tallbacka. L. (Project Manager), **1994.** Baltic Geothermal Energy Project. Feasibility Study. Final Report; Copenhagen, **35** p.
Brangulis, **A.** Vendian and Cambrian of Latvia (stratigraphy, lithology, reservoir properties). In Russian, Zinatne Publ.; Riga **(1985).**
Mahler, A. Geothermal Plant in Thisted with Absorption Heat Pump and Case Example for Liepaja. Proceedings of Latvian - Danish seminar on "Groundwater and Geothermal Energy"; Riga-Copenhagen. **1994.** pp. 277-286.