

## NUMERICAL SIMULATION EXPERIENCE

GeothermEx has conducted three-dimensional numerical simulation of more different reservoirs than any other organization in the world – nearly 60 to date. Our experience includes numerical simulation of all categories of geothermal systems:

- Single-phase water systems
- Single-phase steam systems
- Two-phase (water and steam) systems
- Two-phase systems with CO<sub>2</sub> gas
- Hyper-saline brine systems
- Systems with magmatic heat transfer
- Single porosity and dual porosity systems

### Examples of Reservoirs Simulated by GeothermEx

Reservoir	Country	MW Capacity	Year	Model Type*
Central Plain	Jordan		2006	2D, W
Tiwi, Luzon	Philippines	330	1983-1985 1997	3D, 2P; 3D, 2P
MakBan, Luzon	Philippines	400	1997	3D, 2P
Kokubu, Kyushu	Japan		1986-1987	3D ,2P, M
Hakkoda, Honshu	Japan		1986-1987	3D, 2P, M
Minami Aizu, Honshu	Japan		1986-1987	3D, W
Niseko, Hokkaido	Japan		1986-1987	3D, W, M
Okuaizu, Honshu	Japan	55	1986-1989	3D, 2P, G
Yanaizu-Nishiyama, Honshu	Japan	55	2001-2002	3D, DP, 2P, G
Takigami, Kyushu	Japan	25	1986-1992	3D, W
Onikobe, Honshu	Japan	12.5	1988-1989	3D, 2P
Uenotai, Honshu	Japan	25	1988-1993; 1996; 2002-2003	3D, 2P
Ohtake, Kyushu	Japan	12.5	1992-1993	3D, 2P
Wasabizawa, Honshu	Japan		1997-1998	3D, 2P

Reservoir	Country	MW Capacity	Year	Model Type*
Germencik	Turkey	47.4	2007; 2009	3D, W, G
Lihir Island	Papua New Guinea		1987-1991	3D, 2P, G
Kawerau	New Zealand	20	2006	3D, 2P
Cooper Basin (EGS project)	Australia		2006	3D, 2P
Penola Trough	Australia		2010	3D, W
Olkaria	Kenya	140	2005; 2007-2008; 2010	3D, 2P, DP
Ribeira Grande/Pico Vermelho	Azores, Portugal	14	2002-2003, 2008	3D, 2P, TR
Wayang Windu (Java)	Indonesia	220	1995	3D, 2P
Raja Basa (Sumatra)	Indonesia		2008	3D, 2P, G
Rantau Detap (Sumatra)	Indonesia		2008	3D, 2P, G
Muara Laboeh (Sumatra)	Indonesia		2008	3D, 2P
Mofete (Naples)	Italy		1986-1987	3D, 2P
Latera (Latium)	Italy	30	1985-1987	3D, 2P, G
Cerro Prieto	Mexico	620	1989-1993 1998- 1999 2005; 2009	3D, 2P; 3D, DP, 2P
Las Tres Vírgenes	Mexico	10	2003; 2008	3D, 2P
Los Azufres	Mexico	93	2003; 2008	3D, 2P, G
Los Humeros	Mexico	35	2003; 2008	3D, 2P, G
Zunil	Guatemala	27	1989; 1993; 1995- 1996; 2003	3D, 2P
Amatitlán	Guatemala	25	1995	3D, 2P
San Jacinto	Nicaragua	72	2010-2011	3D, 2P, DP

Reservoir	Country	MW Capacity	Year	Model Type*
Miravalles, Guanacaste Province	Costa Rica	175	1996-1998; 2001-2002	3D, 2P; 3D, 2P, CL
Las Pailas, Guanacaste Province	Costa Rica		2003	3D, 2P, CL
The Geysers, California (entire field)	United States	2,200 installed (currently generating ~1,000)	1991-1992; 1998; 2000; 2005	3D, DP, 2P, TR, Pipe
The Geysers, California (GGC Area)	United States	245	1988	3D, 2P
The Geysers, California (NCPA Area)	United States	220	1988; 2000; 2008	3D, 2P, DP, Pipe
The Geysers, California (Aidlin Area)	United States	25	2001-2002	3D, DP, 2P, G
The Geysers, California (Unit 15 / WGP Unit 1 area)	United States	25	2009; 2011	3D, DP, 2P
East Mesa, California (Ormesa I)	United States	30	1986-1987	3D, W
East Mesa, California (Ormesa II)	United States	20	1987-1988	3D, W
East Mesa, California (Ormesa IE)	United States	10	1988	3D, W
East Mesa, California (Ormesa IH)	United States	10	1989	3D, W
East Mesa, California (GEMLP)	United States	47	1992-1994	3D, W
Heber, California	United States	80	1992-1994; 1999; 2001; 2004	3D, W
Coso Hot Springs, California (LADWP Leasehold)	United States		1986-1989	3D, 2P
Coso Hot Springs, California (CECI Leasehold)	United States	268	1988-1991, 2006	3D, 2P, G, TR
Salton Sea, California (Magma Lease)	United States	152	1987-1989; 1993-1994	3D, HSB
Salton Sea, California (Unocal Lease)	United States	80	1993, 1995	3D, HSB
Salton Sea, California (Entire field)	United States	280	1996-1999; 2003; 2006	3D, HSB, MIN
Roosevelt Hot Springs, Utah	United States	25	1985-1986; 2001; 2005, 2007	3D, W

Reservoir	Country	MW Capacity	Year	Model Type*
South Brawley, California	United States		1992	3D, HSB
Mammoth (Long Valley), California	United States	37.5	1989-1992; 1995-1996; 1998-1999; 2001	3D, W
Blue Mountain, Nevada	United States	49	2010-2011	3D, W
Desert Peak, Nevada	United States	10	1991	2D, W
Desert Peak, Nevada (EGS project)	United States		2003-2004; 2009	3D, DP, W
Tuscarora, Nevada	United States	18	2010-2011	3D, W
San Emidio, Nevada	United States	16	2011	3D, W
Soda Lake, Nevada	United States	15	1991	2D, W
Steamboat Springs, Nevada	United States	37	1995;1997; 1999; 2001; 2002-2003; 2005; 2007; 2009-2010	3D, 2P
Stillwater, Nevada	United States	15	1991; 2004, 2005; 2009	3D, W
Beowawe, Nevada	United States	15	1998; 1999; 2006	3D, W
Dixie Valley, Nevada	United States	60	1999; 2002; 2005, 2007	3D, 2P, TR
Puna, Hawaii	United States	30	1993-1994; 1996; 1998-1999; 2001-2003; 2006	3D, 2P

\* Model Types:

2D	2-Dimensional	CL	Includes NaCl concentration
3D	3-Dimensional	HSB	Hyper-Saline Brine
DP	Dual Porosity	TR	Includes Tracer Transport
W	Single Phase Water	M	Includes Magmatic Heat Transfer
2P	Two Phase (Water+Steam)	MIN	Includes Mineral Recovery
G	Includes Gas	PIPE	Includes Pipeline Network