

CONSORTIUM TO STUDY TRENDS IN SEISMICITY

Quarterly report:
January 1–March 31, 2018

by

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KANSAS GEOLOGICAL SURVEY
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INTRODUCTION

The Kansas Geological Survey's Consortium to Study Trends in Seismicity (CSTS) is a public-private project aimed at studying trends in seismicity in Kansas. The CSTS is operated by the Kansas Geological Survey (KGS), a research and service division of the University of Kansas with a long history of studying the state's subsurface and seismic characteristics. Current members of the CSTS are from the state's UIC Class 1 disposal well community—wells that are used for disposal of municipal and industrial waste and regulated by the Kansas Department of Health and Environment. Membership in the CSTS is voluntary, with a common goal of understanding seismicity in proximity to member facilities.

About five years ago, seismicity increased significantly in Kansas and throughout the midcontinent. That led to the need to better define and understand seismicity, particularly as it relates to subsurface fluid disposal. The CSTS works to establish the baseline or background seismicity near those facilities and provide a scientific basis for criteria used in differentiating natural from induced seismicity. The CSTS oversees the operation of a seismic network that records and allows accurate location and magnitude estimates of seismicity in proximity to member injection wells for both felt earthquakes and especially for microseismic events that are hundreds of times smaller than routinely possible to detect with current regional seismic networks.

The following report describes three months of CSTS activities (from January 1, 2018 through March 31, 2018), including a discussion of member status; network station installation and operation; earthquakes recorded, identified, and earthquake alerts provided to members; web page development; and plans for the next three months and the coming year. In addition to a fourth quarterly report that will follow this report, an annual report will be provided to members and an annual meeting will be held on **July 18, 2018**, in Wichita.

STATUS OF MEMBERS

The CSTS was established with a two-tier membership system. For Tier 1 members the CSTS provides equipment, installation, and monitoring of a seismograph station; maintains a catalog of seismic events, updated weekly, with a goal of providing e-mail alerts within 24 hours or less of any earthquakes greater than magnitude 2 within 30 miles of a facility; provides quarterly reports of monitoring findings; and hosts an annual meeting at which results are discussed and plans formulated for the coming year.

Tier 2 members have access to information related to the general information about the seismicity being studied by the CSTS and can attend the annual meeting, but do not have the right to vote at that meeting.

The CSTS currently has eleven Tier 1 members and one Tier 2 member.

STATUS OF NETWORK

The CSTS seismic network currently consists of 12 stations in Kearny, Ellsworth, Rice, McPherson, Reno, Kiowa, Sedgwick, Butler, and Johnson counties, Kansas (Figure 1). Waveforms for these stations are available for Tier 1 members on the seismic network page of the CSTS website. For each of those locations, ambient noise tests have been completed, aimed at identifying noise from nearby highways, trains, pump jacks, and other facilities that might interfere with earthquake analysis. Many of the existing sites are in cemeteries, on government property, or in other locations where noise levels are likely to be low. In all cases, written agreements with landowners have been obtained.

Each station consists of a seismic sensor that includes a shallowly buried seismometer embedded in a concrete platform atop a gravel layer, and a digitizer. Ground motion detected by the seismometer is transmitted back to KGS offices in Lawrence real-time via a cellular modem. That communication system is powered by a solar panel that charges two deep-cycle marine batteries. The footprint for each station is approximately 10 feet by 10 feet. The stations have operated with a better than 98% continuous data stream and within designated operational sensitivity and signal-to-noise ratio.

EARTHQUAKE ALERTS, EARTHQUAKE CATALOG

Earthquakes with magnitudes of 2 or larger are below felt levels but represent a threshold above which energy levels provide highly confident automatic analysis with a network as dense as the Consortium network in conjunction with the KGS regional and subregional network. It is therefore reasonable to provide accurate epicenter locations using automated picking routines with results available within minutes of the fault rupture responsible for the event. It will be the practice of the KGS to notify members of a M 2 or larger earthquake within 30 miles of Tier 1 member wells. In the first quarter of the calendar year, there were 20 earthquakes that met these criteria (Table 1), about the same as the previous quarter. Microearthquake activity recorded by the KGS and CSTS networks was up relative to the previous quarter. A total of 150 earthquakes ranging from M 0.4 to 3.5 were recorded within 20 miles of member wells (Figure 2, Table 2). Most epicenters are located in previously identified clusters or along known trends. The largest increase in activity occurred within the cluster of earthquakes in Reno County near Hutchinson. Subnetwork activity (Table 3) was similar to the previous quarter, with the exception of events near station RN01. Subnetwork events near RN01 increased from 62 last quarter to more than 250 this quarter, consistent with the increased activity in the Hutchinson cluster.

INTERESTING TRENDS

Earthquakes that can only be located with incorporation of CSTS stations are part of a confidential database that only CSTS members benefit from prior to publication of the annual report (six months after the draft is released during the annual meeting). The very small earthquakes recorded by the CSTS stations are beginning to provide interesting trends and correlations that can be related to various subsurface data sets. During the first quarter of 2018, a cluster of events occurred in Reno and Sedgwick

counties consistent with structures evident in the Arbuckle Group (Figure 3). These events align with apparent abrupt property changes in crystalline basement rocks as indicated by features in gravity and magnetic data signatures (Figures 4 and 5).

Looking specifically at the Reno County events, epicenters down to M less than 1 are consistent with features previously defined by the larger felt events, which are well documented by local media and provided on the KGS web page. Looking specifically at the extension or tail of the Hutchinson cluster, which generally trends to the south, demonstrates some of the value of incorporating CSTS station data into locations. This trend is not evident on the state regional networks alone. This trend aligns nicely with structures mapped through drilling on the top of Arbuckle (Figure 3).

Looking in proximity to CSTS facilities, there are no microearthquakes (M less than 2 and greater than 0.5) that are mapped outside the Hutchinson cluster and southward trend that are evident only on CSTS stations with the exception of a M 1.1 event located near the southern Rice County line. This event is worth noting and maintaining an awareness of, but unless it is the start of a new trend it does not justify discussion and advanced analysis at this point.

WEB PAGE CONTENT

The CSTS web page (<http://www.kgs.ku.edu/Geophysics/CSTS/index.html>) is operated by the KGS. It includes links to information about meetings, publications, network updates, and seismic updates (for Tier 1 members), and information about the seismic network for Tier 2 members. It includes semi-annual newsletters about earthquake activity, along with access to a comprehensive catalog of events, including time, location, magnitude, and the Seismic Action Score (based on evaluation criteria developed by the State's Induced Seismicity Task Force) for each event. The website also includes a series of pictures and accounts of the installation process and gives a feel for the environment and footprint of each consortium station. Currently there is at least one station within 20 miles of every Tier 1 member's well (Figure 2). A short discussion and set of pictures are posted on the website documenting the installation process.

OTHER ACTIVITIES

Consortium staff members attended an Oklahoma Seismicity Workshop in Norman, Oklahoma, in February. The meeting brought together approximately 200 attendees to discuss the latest information on induced seismicity in the Midcontinent. Rex Buchanan gave a brief talk on the Kansas consortium. Rick Miller gave a presentation for Shelby Peterie entitled "The Role of Far-Field Pressure Diffusion in Triggering Earthquakes in Kansas." Co-authors of that presentation were Shelby Peterie, Rick Miller, John Inten, Julio Gonzales, Rex Buchanan (all of the KGS), and Brandy DeArmond and Mike Cochran of the Kansas Department of Health and Environment (KDHE).

Rex Buchanan and Rick Miller also met with the state of Oklahoma's seismicity task force in Oklahoma City. That meeting included an update on Oklahoma seismicity, latest enforcement activities by the Oklahoma Corporation Commission (OCC), and a presentation on Arbuckle fluid levels by Kyle Murray of the Oklahoma Geological

Survey. Earthquake activity in Oklahoma is generally down, though there has been a recent uptick near Hennessey, northwest of Oklahoma City. The OCC has issued a new directive that orders volume reductions in that area. There was also discussion of scheduling a joint meeting of Kansas and Oklahoma regulatory agencies and geological surveys sometime in the coming two or three months.

KGS is now part of a Federally funded research consortium on induced seismicity. The current members are the state geological surveys of Kansas, Oklahoma, Texas, and New Mexico. This group is still in its infancy, but it could prove to be an effective means of keeping consortium members current with induced seismicity activities (regulator as well as trends) in surrounding states.

Finally, Shelby Peterie was the lead author of a feature article in Eos, a publication of the American Geophysical Union. Entitled “Fluid Injection Wells Can Have a Wide Seismic Reach,” its co-authors were Rick Miller and Rex Buchanan of the KGS and Brandy DeArmond of KDHE. The article is on-line at <https://eos.org/features/fluid-injection-wells-can-have-a-wide-seismic-reach>.

PLANS

Currently all 12 stations are installed and operating well within acceptable response levels. Over the next three months the KGS consortium team will focus almost exclusively on developing rapid techniques and procedures for accurately locating and characterizing extremely low energy earthquake epicenters.

In addition, consortium staff have begun planning and scheduling of presentations and discussion at the consortium’s annual meeting in Wichita. The preliminary program includes time for presentations on the state of the monitoring network, recent earthquake activity, and Arbuckle fluid issues in Kansas. There will also be time allowed for conversation with consortium members about the future directions of the consortium and additional information/activities that members would like to have provided.

CONCLUSION

Agreements for the twelve Tier 1 members and the one Tier 2 member have remained in place. The installed stations have operated successfully, and alerts have been, for the most part, delivered to members as prescribed the agreement. The CSTS continues to look at methods of providing additional information, and looks forward to the annual meeting for face-to-face conversation about seismicity, Class 1 wells, monitoring, and future activities of the Consortium. To enhance the quality and value of the product the CSTS is delivering to its members, feedback from members is essential and highly valued. Please spend time reviewing CSTS products and providing feedback about improvements to current or additional products.

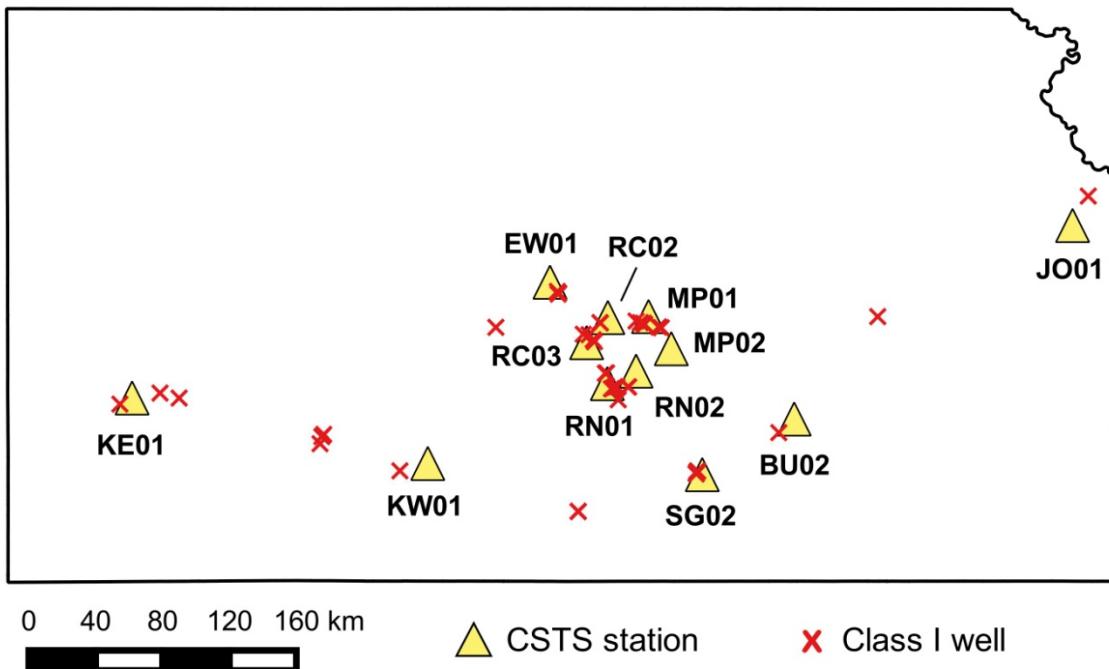


Figure 1. The 12 stations in the current CSTS seismic network.

Table 1. M 2 or larger earthquakes recorded from January 1 to March 30, 2018, with epicenters located within 30 mi of Tier 1 member wells.

Origin Time (UTC)	Latitude	Longitude	Magnitude	County
2018-03-21 00:43:41	38.0140	-97.9800	2.0	Reno
2018-03-18 02:17:16	38.0115	-98.0058	3.2	Reno
2018-03-13 02:43:47	37.6030	-99.0550	2.1	Kiowa
2018-03-08 10:48:21	38.0130	-97.9850	3.5	Reno
2018-03-05 11:12:17	38.0150	-97.9760	2.2	Reno
2018-03-02 21:09:36	38.0180	-97.9710	2.0	Reno
2018-03-02 07:29:23	38.0130	-97.9870	2.5	Reno
2018-03-02 01:47:19	38.0130	-97.9800	2.0	Reno
2018-03-01 21:15:28	38.0188	-97.9952	2.3	Reno
2018-03-01 20:30:42	38.0210	-97.9870	2.3	Reno
2018-03-01 20:27:01	38.0196	-97.9801	3.0	Reno
2018-02-22 23:43:00	38.6520	-97.5350	2.1	Saline
2018-02-13 01:14:00	38.6890	-97.5510	2.0	Saline
2018-02-08 12:36:39	37.4890	-96.7630	2.1	Butler
2018-02-08 05:08:38	37.3670	-97.7540	2.1	Sumner
2018-02-07 06:18:25	38.0300	-97.9940	2.2	Reno
2018-02-07 06:02:57	38.0190	-97.9920	2.0	Reno
2018-02-05 09:18:39	38.0160	-97.9990	2.0	Reno
2018-01-26 11:02:21	37.3280	-97.7680	2.1	Sumner
2018-01-01 01:08:33	37.2450	-97.5130	2.1	Sumner

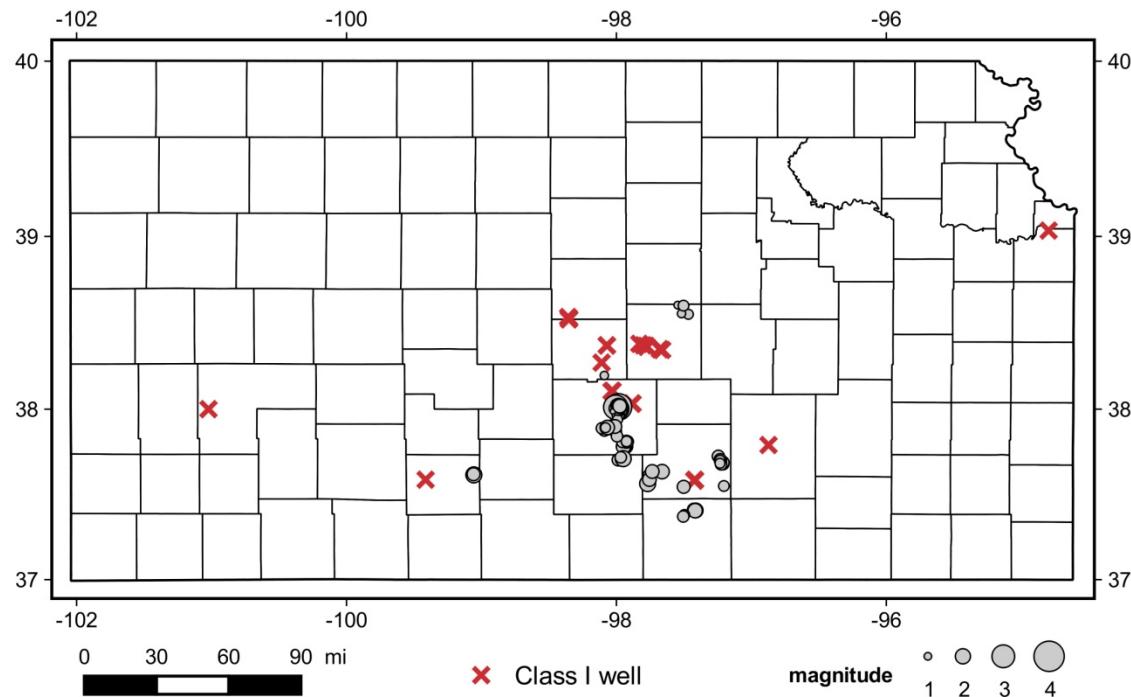


Figure 2. Earthquakes (gray circles) and Class I wells (red Xs) recorded by the KGS and CSTS seismic networks from January 1 to March 30, 2018, located within 20 miles of CSTS member wells.

Table 2. Earthquakes located within 20 miles of member wells.

Origin Time (UTC)	Latitude	Longi-tude	Magni-tude	Origin Time (UTC)	Latitude	Longi-tude	Magni-tude
2018-01-04 04:33:37	37.7800	-97.9490	1.8	2018-03-01 20:30:42	38.0210	-97.9870	2.3
2018-01-04 04:58:48	37.7780	-97.9460	1.4	2018-03-01 20:32:02	38.0240	-97.9820	2.0
2018-01-04 05:58:04	37.7830	-97.9330	1.9	2018-03-01 20:37:28	38.0100	-97.9870	1.1
2018-01-04 06:09:06	37.7800	-97.9400	1.8	2018-03-01 20:53:53	38.0020	-97.9790	1.5
2018-01-04 09:26:02	37.7790	-97.9500	1.5	2018-03-01 20:55:00	38.0030	-97.9870	1.1
2018-01-05 07:29:04	37.7820	-97.9480	1.9	2018-03-01 21:04:50	38.0370	-97.9910	0.7
2018-01-07 23:32:15	37.8690	-98.0000	1.3	2018-03-01 21:15:06	38.0070	-97.9800	1.9
2018-01-09 07:16:49	37.8710	-97.9990	1.3	2018-03-01 21:15:28	38.0188	-97.9952	2.3
2018-01-11 01:04:36	37.4050	-97.4100	1.8	2018-03-01 23:17:24	38.0180	-97.9810	1.6
2018-01-15 17:43:30	37.4040	-97.4100	1.7	2018-03-02 01:47:19	38.0130	-97.9800	2.0
2018-01-16 09:59:25	37.4120	-97.4260	1.7	2018-03-02 02:13:58	38.0130	-98.0020	1.6
2018-01-16 11:17:25	37.4080	-97.4120	1.9	2018-03-02 02:58:54	38.0050	-97.9790	1.5
2018-01-16 11:20:26	37.4060	-97.4170	1.9	2018-03-02 03:16:54	38.0060	-97.9920	1.0
2018-01-16 13:03:54	38.0000	-97.9940	1.0	2018-03-02 07:29:23	38.0130	-97.9870	2.5
2018-01-17 08:58:04	38.0090	-97.9770	1.3	2018-03-02 07:51:15	38.0130	-97.9890	1.6
2018-01-21 13:31:52	37.8840	-98.0500	1.5	2018-03-02 21:09:36	38.0180	-97.9710	2.0
2018-01-22 01:12:15	37.8830	-98.0650	1.1	2018-03-02 23:54:21	38.0080	-97.9840	2.0
2018-01-24 10:05:00	37.3810	-97.4970	1.4	2018-03-03 01:12:53	38.0030	-97.9970	1.5
2018-01-25 02:58:41	37.9100	-98.0130	1.7	2018-03-05 08:42:57	38.0134	-97.9630	1.9
2018-01-29 02:23:16	37.3720	-97.5050	1.5	2018-03-05 11:12:17	38.0150	-97.9760	2.2
2018-01-29 06:22:42	37.5460	-97.5020	1.7	2018-03-05 16:46:26	38.0160	-97.9760	2.0
2018-02-01 19:52:40	38.1960	-98.0900	1.1	2018-03-06 03:11:38	38.0090	-97.9860	1.4
2018-02-02 10:50:54	37.5830	-97.7590	1.4	2018-03-08 02:09:39	38.0020	-97.9820	1.7
2018-02-02 16:55:59	37.6120	-97.7560	1.7	2018-03-08 03:16:58	38.0190	-97.9740	1.4
2018-02-05 04:59:31	38.0160	-97.9730	1.5	2018-03-08 10:48:21	38.0130	-97.9850	3.5
2018-02-05 07:31:05	38.0140	-97.9800	1.4	2018-03-08 10:49:28	38.0020	-97.9870	2.8
2018-02-05 09:18:39	38.0160	-97.9990	2.0	2018-03-08 11:00:39	38.0130	-97.9810	1.8
2018-02-05 17:05:08	38.0150	-97.9680	1.8	2018-03-08 11:35:03	38.0030	-97.9820	1.3
2018-02-05 17:35:43	38.0050	-97.9730	1.7	2018-03-08 11:44:47	38.0140	-97.9730	1.8
2018-02-06 05:45:43	38.0120	-97.9610	1.5	2018-03-08 11:45:41	38.0160	-97.9860	1.7
2018-02-06 15:01:58	38.0070	-97.9870	1.6	2018-03-08 13:17:00	38.0090	-97.9800	1.7
2018-02-06 15:23:08	38.0190	-97.9900	1.9	2018-03-08 13:30:28	38.0150	-97.9840	1.7
2018-02-06 17:02:58	37.9920	-97.9690	1.4	2018-03-08 17:22:22	37.8886	-98.1078	1.5
2018-02-07 05:23:30	38.0220	-97.9900	1.7	2018-03-09 03:56:22	38.0080	-97.9830	1.3
2018-02-07 06:02:57	38.0190	-97.9920	2.0	2018-03-10 01:27:44	38.0190	-97.9740	1.7
2018-02-07 06:18:25	38.0300	-97.9940	2.2	2018-03-10 16:18:40	37.9970	-97.9890	0.5
2018-02-07 10:25:08	38.0070	-97.9870	0.7	2018-03-12 00:11:20	38.0170	-97.9730	1.8
2018-02-08 07:10:33	38.0210	-97.9620	1.6	2018-03-12 05:25:30	38.0190	-97.9830	1.3
2018-02-08 09:15:05	37.8900	-98.0660	1.4	2018-03-12 10:06:16	38.0290	-97.9830	1.5
2018-02-08 10:04:15	37.8780	-98.0890	1.6	2018-03-12 11:26:36	38.0150	-98.0010	1.6
2018-02-09 09:32:10	38.0190	-97.9840	2.2	2018-03-12 12:03:06	38.0200	-97.9950	1.4
2018-02-09 13:33:08	38.0230	-97.9800	1.6	2018-03-13 01:42:57	38.5550	-97.5180	1.1
2018-02-12 04:37:04	37.8160	-97.9290	1.2	2018-03-13 02:43:50	37.6160	-99.0570	2.1
2018-02-12 05:05:19	37.8140	-97.9210	1.2	2018-03-13 05:59:22	38.0090	-97.9980	0.4
2018-02-12 05:43:32	37.8100	-97.9260	1.7	2018-03-13 06:09:21	38.6040	-97.5460	1.0
2018-02-12 08:03:46	37.8120	-97.9170	1.3	2018-03-13 09:53:26	38.0170	-97.9940	1.7
2018-02-12 08:37:18	37.8100	-97.9220	1.3	2018-03-13 18:29:51	38.0040	-97.9770	1.6
2018-02-12 09:28:58	37.8090	-97.9560	1.5	2018-03-13 21:39:19	38.0140	-97.9820	1.7
2018-02-12 09:35:45	37.8100	-97.9190	1.6	2018-03-13 23:34:19	37.6200	-99.0590	1.7
2018-02-12 09:46:56	37.5510	-97.2040	1.4	2018-03-14 12:35:12	38.0140	-97.9860	1.7
2018-02-12 14:48:37	37.8120	-97.9250	1.4	2018-03-17 17:18:19	37.8960	-98.0570	1.7
2018-02-16 14:13:56	38.0070	-97.9890	1.7	2018-03-18 02:17:16	38.0115	-98.0058	3.2
2018-02-17 13:09:37	38.0210	-97.9790	1.5	2018-03-18 02:22:07	38.0170	-97.9820	1.4
2018-02-17 16:44:59	38.0174	-97.9747	1.8	2018-03-18 02:26:07	38.0245	-98.0010	1.5
2018-02-17 17:12:14	37.6350	-97.6620	1.9	2018-03-18 02:34:12	38.0150	-97.9830	1.5
2018-02-21 14:37:04	37.8420	-97.9960	1.5	2018-03-18 03:50:05	38.0030	-97.9910	1.5
2018-02-22 14:48:14	37.7040	-97.9870	1.6	2018-03-18 06:03:28	38.0040	-97.9930	1.6
2018-02-22 19:32:00	38.5510	-97.4670	1.3	2018-03-18 06:36:45	38.0040	-98.0010	1.9
2018-02-26 21:14:16	37.7110	-97.9500	2.1	2018-03-18 17:15:26	37.9680	-97.9870	1.6
2018-02-28 09:48:30	37.7190	-97.9680	1.5	2018-03-19 09:16:01	37.5650	-97.7690	2.1

Table 2. Continued

Origin Time (UTC)	Latitude	Longi-tude	Magni-tude	Origin Time (UTC)	Latitude	Longi-tude	Magni-tude
2018-03-20 17:07:05	38.0190	-97.9840	2.0	2018-03-26 20:07:14	37.8930	-98.0680	1.9
2018-03-21 00:43:41	38.0140	-97.9800	2.0	2018-03-26 22:51:28	37.8920	-98.0810	1.3
2018-03-21 02:16:16	37.9910	-97.9820	1.5	2018-03-27 01:14:39	37.7020	-97.2320	1.3
2018-03-21 03:25:44	37.9390	-97.9920	1.3	2018-03-28 11:30:30	38.0210	-97.9740	1.7
2018-03-22 15:59:51	37.8990	-98.0120	1.8	2018-03-28 11:46:40	38.0020	-97.9950	0.9
2018-03-23 04:17:17	38.0180	-97.9770	1.7	2018-03-28 19:28:38	38.0010	-97.9860	1.7
2018-03-24 03:34:26	38.0080	-97.9770	1.3	2018-03-29 03:53:18	38.6010	-97.5030	1.4
2018-03-24 04:15:33	38.0120	-97.9780	1.5	2018-03-29 07:15:18	38.0230	-97.9740	1.5
2018-03-24 21:57:22	37.7250	-97.2450	1.6	2018-03-29 11:29:48	37.5890	-97.7560	1.8
2018-03-24 23:56:25	37.6790	-97.2090	1.5	2018-03-29 19:21:28	38.0070	-97.9800	1.5
2018-03-25 10:44:38	37.6980	-97.2290	1.1	2018-03-30 05:06:07	37.6840	-97.2330	1.3
2018-03-25 13:26:01	37.6880	-97.2130	1.7	2018-03-30 22:05:32	37.9870	-98.0270	0.7
2018-03-25 17:18:30	37.6990	-97.2290	1.6	2018-03-31 02:11:51	38.0180	-97.9760	1.8
2018-03-26 11:47:51	37.6780	-97.2250	1.5	2018-03-31 03:10:32	37.6360	-97.7350	1.8
2018-03-26 17:06:05	37.7050	-97.2310	1.6				

Table 3. Possible subnetwork earthquakes from January 1 to March 30, 2018, recorded within 12 miles of member wells (the largest published distance between an induced earthquake swarm and causal well). Epicentral distance is the estimated distance from the earthquake epicenter to the seismic station where it was recorded.

Station	Origin Time (UTC)	Distance	Magni-tude	Station	Origin Time (UTC)	Distance	Magni-tude
BU02	2018-01-01 03:24:35	1.2	-0.6	RC03	2018-01-10 11:11:39	8.1	0.2
BU02	2018-01-01 03:45:20	0.4	-0.6	RC03	2018-01-10 11:12:42	7.7	0.6
BU02	2018-01-01 03:47:26	2.9	-0.4	RC03	2018-01-11 03:22:29	7.0	0.3
BU02	2018-01-18 15:58:22	2.7	0.0	RC03	2018-01-12 11:18:11	7.7	0.4
EW01	2018-02-20 03:16:01	6.4	0.1	RC03	2018-01-16 03:20:28	7.1	0.2
EW01	2018-03-09 10:54:02	2.1	-0.4	RC03	2018-01-16 03:20:54	8.4	0.2
EW01	2018-03-21 18:45:09	2.7	-0.4	RC03	2018-01-16 03:22:18	7.3	0.3
KE01	2018-03-14 05:23:02	10.2	0.4	RC03	2018-01-16 03:22:50	8.1	0.2
KW01	2018-03-14 15:14:07	10.6	0.8	RC03	2018-01-17 11:19:04	8.9	0.4
MP01	2018-02-18 10:00:14	3.4	0.1	RC03	2018-01-18 19:13:09	7.2	0.0
MP02	2018-01-01 01:48:40	2.6	0.1	RC03	2018-01-23 11:18:24	7.7	0.1
MP02	2018-01-01 05:09:47	2.6	-0.2	RC03	2018-01-24 03:16:35	8.9	0.2
MP02	2018-01-17 14:34:04	3.9	0.0	RC03	2018-01-24 03:17:04	8.2	0.4
MP02	2018-01-21 08:08:14	7.9	0.2	RC03	2018-01-24 03:19:01	9.7	0.7
MP02	2018-03-02 05:16:58	4.1	-0.2	RC03	2018-01-25 03:18:29	8.1	0.0
MP02	2018-03-15 14:04:23	2.2	-0.2	RC03	2018-01-25 03:19:36	8.4	0.4
MP02	2018-03-15 15:49:14	3.3	-0.2	RC03	2018-01-25 11:23:34	7.7	0.4
MP02	2018-03-16 00:43:34	2.3	-0.4	RC03	2018-01-25 11:23:59	11.3	0.6
MP02	2018-03-23 08:49:21	5.4	0.1	RC03	2018-02-01 03:19:55	8.9	0.2
MP02	2018-03-25 01:56:49	3.5	0.1	RC03	2018-02-01 03:20:34	8.7	0.4
RC02	2018-01-01 04:34:04	5.3	0.1	RC03	2018-02-01 19:53:34	7.9	0.6
RC02	2018-01-01 05:34:25	4.7	0.2	RC03	2018-02-02 03:21:33	8.3	0.4
RC02	2018-01-16 10:43:19	5.5	0.4	RC03	2018-02-02 11:18:30	7.4	0.4
RC02	2018-01-16 12:17:32	4.0	0.0	RC03	2018-02-06 03:14:01	8.3	0.5
RC02	2018-01-17 09:09:41	4.6	0.1	RC03	2018-02-06 03:14:45	8.3	0.4
RC03	2018-01-04 03:24:17	9.2	0.6	RC03	2018-02-06 19:15:14	7.7	0.4
RC03	2018-01-05 03:19:57	8.8	0.1	RC03	2018-02-07 03:15:07	7.6	0.7
RC03	2018-01-05 03:20:18	8.3	0.0	RC03	2018-02-07 03:16:38	8.0	0.7
RC03	2018-01-05 03:20:37	7.6	0.2	RC03	2018-02-07 15:20:14	7.3	0.6
RC03	2018-01-05 11:10:01	8.2	0.3	RC03	2018-02-08 11:26:14	8.6	0.1
RC03	2018-01-06 03:02:36	8.8	0.4	RC03	2018-02-08 11:26:21	6.9	0.4
RC03	2018-01-06 03:03:18	8.1	0.5	RC03	2018-02-08 11:26:45	8.6	0.6
RC03	2018-01-09 11:13:59	8.2	0.2	RC03	2018-02-13 11:22:49	7.3	0.7
RC03	2018-01-10 11:11:39	9.3	0.1	RC03	2018-02-13 23:20:38	8.4	0.5

Table 3. Continued

Station	Origin Time (UTC)	Distance	Magnitude	Station	Origin Time (UTC)	Distance	Magnitude
RC03	2018-02-13 23:21:25	7.8	0.5	RC03	2018-03-27 02:15:21	7.1	0.4
RC03	2018-02-14 11:19:12	6.8	0.4	RC03	2018-03-27 18:22:09	7.2	0.5
RC03	2018-02-14 11:19:39	8.3	0.6	RC03	2018-03-28 02:18:54	8.7	0.4
RC03	2018-02-14 19:16:40	8.1	0.6	RC03	2018-03-28 06:44:58	7.6	0.4
RC03	2018-02-15 07:08:47	8.0	0.0	RC03	2018-03-28 18:19:54	7.0	0.6
RC03	2018-02-15 07:09:09	8.4	0.5	RC03	2018-03-29 02:17:49	6.8	0.5
RC03	2018-02-15 19:22:50	8.9	0.5	RC03	2018-03-29 02:18:28	7.6	0.8
RC03	2018-02-20 03:06:48	8.2	0.5	RC03	2018-03-29 02:20:18	7.1	0.7
RC03	2018-02-20 03:07:35	9.3	0.5	RN01	2018-01-12 07:24:44	5.6	-0.4
RC03	2018-02-21 03:22:07	8.3	0.8	RN01	2018-01-12 07:47:29	4.6	-0.4
RC03	2018-02-21 03:22:57	7.8	0.9	RN01	2018-01-17 17:18:07	5.0	-0.2
RC03	2018-02-21 19:16:41	7.6	0.7	RN01	2018-01-25 06:50:41	5.0	0.4
RC03	2018-02-21 20:53:14	7.1	0.7	RN01	2018-01-26 15:46:32	3.0	0.3
RC03	2018-02-22 11:19:19	8.1	0.4	RN01	2018-01-26 18:26:30	4.8	0.2
RC03	2018-02-22 11:19:42	8.4	0.5	RN01	2018-02-02 05:28:12	4.6	0.0
RC03	2018-02-22 11:20:31	9.5	0.5	RN01	2018-02-05 04:42:27	5.9	0.2
RC03	2018-02-22 19:12:05	8.9	0.7	RN01	2018-02-05 08:16:38	4.8	0.4
RC03	2018-02-23 11:19:53	7.3	0.7	RN01	2018-02-05 08:55:18	4.9	0.6
RC03	2018-02-23 11:20:55	6.9	0.6	RN01	2018-02-05 09:04:17	4.6	0.7
RC03	2018-02-26 11:12:49	7.1	0.7	RN01	2018-02-05 09:26:48	4.8	0.5
RC03	2018-02-27 03:19:20	8.0	0.4	RN01	2018-02-05 09:29:46	4.9	0.1
RC03	2018-02-27 03:20:07	7.4	0.4	RN01	2018-02-05 09:56:49	5.0	0.4
RC03	2018-02-27 03:20:28	8.3	0.5	RN01	2018-02-05 10:33:53	4.9	0.8
RC03	2018-02-27 19:19:27	6.8	0.6	RN01	2018-02-05 13:02:23	4.8	0.6
RC03	2018-02-28 03:21:32	7.3	0.6	RN01	2018-02-05 15:24:59	4.9	0.3
RC03	2018-02-28 19:25:43	8.2	0.5	RN01	2018-02-05 15:26:46	4.9	0.5
RC03	2018-02-28 19:26:25	9.0	0.5	RN01	2018-02-06 15:13:59	4.9	0.6
RC03	2018-02-28 19:28:05	7.7	0.2	RN01	2018-02-06 18:26:45	4.8	0.2
RC03	2018-03-01 03:20:37	7.3	0.3	RN01	2018-02-06 20:28:10	4.6	0.6
RC03	2018-03-01 19:25:52	8.1	1.0	RN01	2018-02-07 01:55:10	5.1	0.4
RC03	2018-03-01 19:29:44	7.2	0.5	RN01	2018-02-07 06:20:27	4.8	0.3
RC03	2018-03-01 19:30:21	7.7	0.4	RN01	2018-02-07 06:20:37	4.9	0.4
RC03	2018-03-07 03:19:00	8.2	0.4	RN01	2018-02-07 06:30:28	4.9	0.2
RC03	2018-03-07 03:19:15	6.2	0.2	RN01	2018-02-07 06:57:24	4.8	0.7
RC03	2018-03-08 19:19:39	7.0	0.8	RN01	2018-02-07 07:19:31	4.9	0.9
RC03	2018-03-08 19:20:23	6.6	0.6	RN01	2018-02-07 09:21:03	4.8	0.8
RC03	2018-03-09 11:21:04	7.2	1.1	RN01	2018-02-07 09:51:52	4.5	0.4
RC03	2018-03-10 01:18:22	9.1	0.7	RN01	2018-02-07 09:52:40	5.0	0.4
RC03	2018-03-13 02:22:06	7.4	1.1	RN01	2018-02-07 13:25:57	4.7	0.5
RC03	2018-03-13 10:18:07	7.6	0.7	RN01	2018-02-08 07:30:16	4.6	0.7
RC03	2018-03-14 10:18:20	8.6	0.5	RN01	2018-02-08 13:33:17	4.7	0.3
RC03	2018-03-14 10:18:54	7.5	0.4	RN01	2018-02-10 00:02:27	4.8	0.7
RC03	2018-03-14 18:17:10	7.1	0.4	RN01	2018-02-10 05:27:50	4.8	0.4
RC03	2018-03-15 02:18:36	7.3	0.5	RN01	2018-02-10 23:38:55	4.7	0.3
RC03	2018-03-16 02:18:11	7.9	0.6	RN01	2018-02-11 12:19:12	4.9	0.9
RC03	2018-03-16 10:16:07	8.2	0.7	RN01	2018-02-14 09:09:34	4.9	0.1
RC03	2018-03-16 10:18:19	8.7	0.9	RN01	2018-02-14 13:17:52	4.9	0.1
RC03	2018-03-20 10:23:15	6.7	0.0	RN01	2018-02-16 20:04:36	4.9	0.0
RC03	2018-03-20 10:23:33	6.9	0.2	RN01	2018-02-17 02:39:19	4.5	0.3
RC03	2018-03-20 18:21:47	8.0	0.6	RN01	2018-02-18 15:28:02	5.0	0.6
RC03	2018-03-20 18:23:40	6.8	0.6	RN01	2018-02-20 05:02:30	4.8	-0.2
RC03	2018-03-21 10:18:12	6.7	0.4	RN01	2018-02-20 06:15:50	4.8	0.4
RC03	2018-03-21 10:18:32	7.6	0.4	RN01	2018-02-20 11:58:15	4.8	0.2
RC03	2018-03-22 02:20:44	6.8	0.4	RN01	2018-02-20 13:54:28	4.9	1.0
RC03	2018-03-22 02:22:15	7.9	0.7	RN01	2018-02-23 00:50:37	4.8	0.3
RC03	2018-03-23 02:19:58	7.7	0.4	RN01	2018-02-28 12:48:06	3.5	0.4
RC03	2018-03-23 02:20:33	7.7	0.5	RN01	2018-03-01 20:10:19	1.4	-0.9
RC03	2018-03-23 10:16:50	9.3	0.4	RN01	2018-03-01 20:45:41	4.8	0.1
RC03	2018-03-23 10:17:55	7.4	0.4	RN01	2018-03-01 23:26:57	4.8	0.0
RC03	2018-03-23 10:18:34	8.4	0.4	RN01	2018-03-02 00:31:39	5.1	0.1

Table 3. Continued

Station	Origin Time (UTC)	Distance	Magnitude	Station	Origin Time (UTC)	Distance	Magnitude
RN01	2018-03-02 00:38:18	4.9	0.6	RN01	2018-03-08 10:56:41	4.7	0.5
RN01	2018-03-02 02:10:53	4.7	0.1	RN01	2018-03-08 10:57:31	5.0	0.9
RN01	2018-03-02 02:22:20	4.9	0.6	RN01	2018-03-08 11:03:33	3.3	0.3
RN01	2018-03-02 02:26:05	4.9	0.6	RN01	2018-03-08 11:06:03	4.9	0.7
RN01	2018-03-02 02:35:19	4.8	0.2	RN01	2018-03-08 11:07:44	4.9	0.8
RN01	2018-03-02 02:48:59	5.0	0.5	RN01	2018-03-08 11:10:17	4.9	0.3
RN01	2018-03-02 03:10:25	5.0	0.1	RN01	2018-03-08 11:48:46	4.9	0.5
RN01	2018-03-02 03:10:31	4.9	-0.2	RN01	2018-03-08 11:55:45	4.8	0.0
RN01	2018-03-02 03:20:23	4.8	0.2	RN01	2018-03-08 12:09:10	4.9	0.3
RN01	2018-03-02 03:45:43	4.9	0.4	RN01	2018-03-08 12:17:12	4.9	0.2
RN01	2018-03-02 04:09:52	4.9	0.3	RN01	2018-03-08 12:31:34	4.7	0.4
RN01	2018-03-02 04:51:34	4.8	0.5	RN01	2018-03-08 12:43:39	4.9	0.7
RN01	2018-03-02 05:26:09	4.9	0.4	RN01	2018-03-08 12:50:36	4.9	0.7
RN01	2018-03-02 07:40:29	4.9	0.3	RN01	2018-03-08 13:50:16	4.8	0.2
RN01	2018-03-02 07:52:09	4.9	1.0	RN01	2018-03-08 14:40:00	4.7	0.1
RN01	2018-03-02 08:59:00	5.1	0.4	RN01	2018-03-08 15:10:20	5.0	0.0
RN01	2018-03-02 09:33:53	4.7	0.4	RN01	2018-03-08 17:46:33	4.8	0.2
RN01	2018-03-02 12:35:20	4.9	0.5	RN01	2018-03-08 17:54:36	4.8	0.8
RN01	2018-03-02 12:51:40	4.8	0.3	RN01	2018-03-08 19:33:07	4.8	0.0
RN01	2018-03-02 12:58:39	4.9	0.6	RN01	2018-03-08 20:01:19	5.0	0.3
RN01	2018-03-02 14:25:19	4.8	0.4	RN01	2018-03-08 20:40:49	4.9	0.2
RN01	2018-03-02 21:15:27	4.8	0.1	RN01	2018-03-08 21:10:22	4.6	0.3
RN01	2018-03-02 21:27:41	4.8	0.0	RN01	2018-03-08 22:53:15	4.9	-0.2
RN01	2018-03-02 22:48:22	4.5	0.4	RN01	2018-03-08 23:40:14	10.1	0.5
RN01	2018-03-03 00:59:43	5.0	0.1	RN01	2018-03-09 08:48:12	5.0	0.3
RN01	2018-03-03 01:14:18	4.9	0.4	RN01	2018-03-09 11:39:04	11.8	0.7
RN01	2018-03-03 02:29:55	4.8	0.2	RN01	2018-03-09 12:56:34	4.9	0.1
RN01	2018-03-03 02:30:05	4.7	-0.2	RN01	2018-03-09 14:50:58	4.0	0.1
RN01	2018-03-03 02:59:57	4.8	0.4	RN01	2018-03-09 15:12:46	4.6	0.1
RN01	2018-03-03 03:17:54	4.8	0.8	RN01	2018-03-09 17:43:22	4.8	0.0
RN01	2018-03-03 03:43:54	4.8	0.1	RN01	2018-03-09 20:49:38	4.5	0.3
RN01	2018-03-03 03:51:01	4.9	0.7	RN01	2018-03-09 21:32:36	4.5	0.0
RN01	2018-03-03 04:40:14	4.8	0.0	RN01	2018-03-09 21:33:54	4.7	0.1
RN01	2018-03-03 06:00:11	4.2	0.1	RN01	2018-03-09 21:35:03	4.8	0.0
RN01	2018-03-03 14:44:23	4.7	0.0	RN01	2018-03-09 21:50:55	5.1	0.1
RN01	2018-03-03 19:11:49	4.9	0.1	RN01	2018-03-10 01:11:27	4.9	0.2
RN01	2018-03-04 05:30:52	4.8	0.0	RN01	2018-03-10 01:45:21	4.9	0.1
RN01	2018-03-05 11:15:27	5.2	-0.2	RN01	2018-03-10 04:56:56	4.9	0.4
RN01	2018-03-05 11:21:04	4.8	0.4	RN01	2018-03-10 07:47:26	5.0	0.4
RN01	2018-03-05 12:52:18	4.9	0.6	RN01	2018-03-10 09:50:03	4.8	0.4
RN01	2018-03-05 16:53:50	4.9	0.1	RN01	2018-03-10 12:19:56	4.8	0.4
RN01	2018-03-05 16:54:08	4.8	-0.4	RN01	2018-03-10 13:24:28	5.1	0.4
RN01	2018-03-06 03:11:25	4.9	0.1	RN01	2018-03-10 15:05:34	4.8	0.1
RN01	2018-03-06 04:14:08	4.8	0.3	RN01	2018-03-10 15:29:10	4.8	0.4
RN01	2018-03-06 05:27:32	4.9	0.4	RN01	2018-03-10 15:55:49	3.4	0.2
RN01	2018-03-06 08:06:22	4.8	0.0	RN01	2018-03-10 16:18:57	4.9	0.2
RN01	2018-03-06 21:17:06	4.9	0.8	RN01	2018-03-11 02:22:55	4.8	0.8
RN01	2018-03-07 02:36:52	4.8	0.4	RN01	2018-03-11 04:33:26	5.0	0.2
RN01	2018-03-07 03:28:39	4.8	0.4	RN01	2018-03-11 22:00:19	4.9	0.8
RN01	2018-03-07 03:58:31	5.0	0.7	RN01	2018-03-12 02:03:35	5.0	0.3
RN01	2018-03-07 04:27:41	4.9	0.7	RN01	2018-03-12 02:23:19	4.9	0.4
RN01	2018-03-07 05:37:16	4.8	0.0	RN01	2018-03-12 09:32:24	4.8	0.3
RN01	2018-03-07 06:27:34	4.9	0.3	RN01	2018-03-12 11:14:18	4.8	0.5
RN01	2018-03-07 10:07:47	4.8	0.1	RN01	2018-03-12 11:27:18	5.0	0.9
RN01	2018-03-08 02:11:21	4.9	0.4	RN01	2018-03-12 12:41:15	4.7	0.6
RN01	2018-03-08 03:41:19	4.8	0.4	RN01	2018-03-12 13:08:09	4.7	0.7
RN01	2018-03-08 03:44:23	4.9	0.1	RN01	2018-03-12 13:08:09	4.6	0.4
RN01	2018-03-08 10:49:41	4.7	-0.2	RN01	2018-03-12 15:44:52	4.9	0.2
RN01	2018-03-08 10:49:59	4.8	0.3	RN01	2018-03-12 15:55:41	4.8	-0.4
RN01	2018-03-08 10:55:20	4.8	0.2	RN01	2018-03-12 19:11:48	4.8	0.1

Table 3. Continued

Station	Origin Time (UTC)	Distance	Magnitude	Station	Origin Time (UTC)	Distance	Magnitude
RN01	2018-03-12 19:50:19	4.9	0.4	RN01	2018-03-22 03:34:06	4.7	0.3
RN01	2018-03-13 01:31:40	4.9	0.1	RN01	2018-03-22 08:29:38	4.8	0.4
RN01	2018-03-13 02:29:52	11.8	0.4	RN01	2018-03-22 10:56:09	4.9	0.5
RN01	2018-03-13 11:39:01	4.7	0.4	RN01	2018-03-23 01:32:36	5.0	0.4
RN01	2018-03-13 12:30:50	4.9	0.1	RN01	2018-03-23 02:06:32	2.9	-0.6
RN01	2018-03-13 18:39:59	4.7	0.3	RN01	2018-03-23 03:45:52	4.8	0.4
RN01	2018-03-13 19:00:51	4.7	0.1	RN01	2018-03-23 08:49:43	5.1	0.1
RN01	2018-03-13 19:15:10	4.6	0.4	RN01	2018-03-23 08:52:12	5.2	0.1
RN01	2018-03-13 20:46:02	4.5	0.4	RN01	2018-03-23 11:25:51	4.9	0.4
RN01	2018-03-13 23:49:09	5.0	0.4	RN01	2018-03-23 13:45:18	4.6	0.1
RN01	2018-03-14 00:00:19	3.9	0.3	RN01	2018-03-24 00:32:10	6.7	0.6
RN01	2018-03-14 13:15:53	4.8	0.0	RN01	2018-03-24 17:17:21	5.0	0.9
RN01	2018-03-14 13:16:21	4.9	0.4	RN01	2018-03-24 23:35:24	5.1	0.4
RN01	2018-03-14 13:57:31	4.9	0.5	RN01	2018-03-27 09:06:48	5.1	0.4
RN01	2018-03-14 14:34:03	5.0	0.4	RN01	2018-03-27 09:30:34	4.7	0.5
RN01	2018-03-14 17:00:24	4.9	0.3	RN01	2018-03-27 09:31:05	4.8	0.1
RN01	2018-03-15 12:31:15	4.8	0.4	RN01	2018-03-27 13:18:45	4.7	0.6
RN01	2018-03-16 10:08:23	4.3	-0.4	RN01	2018-03-28 11:38:42	4.7	0.2
RN01	2018-03-16 16:06:33	5.1	0.0	RN01	2018-03-28 11:55:42	4.7	0.5
RN01	2018-03-17 04:48:12	4.9	0.1	RN01	2018-03-28 12:57:44	11.0	0.0
RN01	2018-03-17 11:00:53	4.9	0.1	RN01	2018-03-28 19:17:09	4.8	0.4
RN01	2018-03-17 12:11:36	4.7	0.2	RN01	2018-03-29 07:52:42	4.8	0.1
RN01	2018-03-17 13:49:46	4.8	0.4	RN01	2018-03-31 07:27:13	5.0	0.1
RN01	2018-03-17 14:15:08	4.6	-0.4	RN01	2018-03-31 10:08:13	4.9	-0.2
RN01	2018-03-17 14:57:10	4.8	-0.2	RN01	2018-03-31 14:00:11	4.9	0.6
RN01	2018-03-17 16:41:26	11.3	0.2	RN02	2018-01-05 23:54:28	7.5	-0.2
RN01	2018-03-17 18:59:47	4.4	0.2	RN02	2018-01-12 05:55:21	10.0	0.3
RN01	2018-03-18 02:22:44	4.6	0.6	RN02	2018-01-13 05:51:48	9.1	0.2
RN01	2018-03-18 02:24:15	4.3	0.0	RN02	2018-01-13 05:54:20	9.7	-0.2
RN01	2018-03-18 02:24:31	4.9	0.1	RN02	2018-01-19 07:05:11	8.0	0.4
RN01	2018-03-18 02:25:10	4.9	-0.2	RN02	2018-01-20 20:26:25	9.2	0.2
RN01	2018-03-18 02:30:25	4.8	0.6	RN02	2018-01-20 20:27:36	10.6	0.4
RN01	2018-03-18 02:39:19	3.4	0.2	RN02	2018-01-24 05:49:08	10.6	0.4
RN01	2018-03-18 02:41:11	2.6	0.1	RN02	2018-01-24 05:51:03	9.0	0.4
RN01	2018-03-18 02:45:19	4.9	0.2	RN02	2018-01-25 05:44:18	9.4	0.1
RN01	2018-03-18 02:55:07	5.0	0.6	RN02	2018-01-25 05:46:23	8.6	0.2
RN01	2018-03-18 03:51:21	4.8	0.1	RN02	2018-01-25 05:46:23	9.0	0.0
RN01	2018-03-18 04:04:04	4.8	0.0	RN02	2018-01-25 05:47:31	9.4	0.4
RN01	2018-03-18 05:21:39	4.8	0.4	RN02	2018-01-25 05:48:23	8.4	0.3
RN01	2018-03-18 05:38:38	4.9	0.6	RN02	2018-01-25 05:49:33	8.7	0.5
RN01	2018-03-18 06:49:51	4.8	0.5	RN02	2018-01-26 06:02:03	8.9	0.2
RN01	2018-03-18 08:17:33	4.6	0.0	RN02	2018-01-27 03:25:37	8.8	0.3
RN01	2018-03-18 08:39:02	4.8	0.4	RN02	2018-01-27 03:27:18	9.0	0.6
RN01	2018-03-18 17:00:52	4.7	0.1	RN02	2018-01-27 17:10:34	11.9	0.4
RN01	2018-03-18 17:14:53	4.7	0.4	RN02	2018-01-27 17:11:44	10.5	0.3
RN01	2018-03-18 17:16:47	3.5	0.1	RN02	2018-02-02 07:32:33	9.2	0.1
RN01	2018-03-19 02:49:20	4.8	0.1	RN02	2018-02-02 07:35:08	10.2	0.2
RN01	2018-03-19 04:54:10	4.8	0.7	RN02	2018-02-03 05:58:27	10.5	0.3
RN01	2018-03-19 07:24:28	5.8	1.2	RN02	2018-02-03 05:59:41	8.4	0.2
RN01	2018-03-20 08:58:31	4.9	0.6	RN02	2018-02-03 06:01:11	10.6	0.4
RN01	2018-03-20 13:40:14	5.0	1.0	RN02	2018-02-06 05:59:39	9.3	0.2
RN01	2018-03-21 00:13:07	4.8	0.5	RN02	2018-02-13 05:58:55	9.7	0.1
RN01	2018-03-21 00:24:02	4.5	0.3	RN02	2018-02-13 06:03:50	8.6	0.2
RN01	2018-03-21 00:57:17	4.5	0.3	RN02	2018-02-13 06:04:59	10.0	0.1
RN01	2018-03-21 00:57:50	4.9	0.0	RN02	2018-02-15 05:53:54	8.3	0.2
RN01	2018-03-21 01:15:02	5.0	0.3	RN02	2018-02-17 06:02:19	9.0	0.4
RN01	2018-03-21 01:33:34	4.8	0.1	RN02	2018-02-17 06:03:40	8.5	0.0
RN01	2018-03-21 03:34:31	4.9	0.4	RN02	2018-02-20 05:55:11	9.5	0.2
RN01	2018-03-21 08:33:31	4.8	0.8	RN02	2018-02-22 07:16:21	7.5	0.4
RN01	2018-03-22 03:27:21	4.7	-0.4	RN02	2018-02-22 07:24:50	9.7	0.2

Table 3. Continued

Station	Origin Time (UTC)	Distance	Magnitude	Station	Origin Time (UTC)	Distance	Magnitude
RN02	2018-02-23 06:05:16	9.8	0.3	RN02	2018-03-13 05:00:11	9.4	0.3
RN02	2018-02-23 06:06:17	9.6	0.2	RN02	2018-03-13 05:01:13	9.6	0.1
RN02	2018-02-23 06:10:52	8.8	0.9	RN02	2018-03-13 05:03:47	9.4	0.3
RN02	2018-02-23 06:11:56	9.2	0.7	RN02	2018-03-13 05:04:19	9.1	0.4
RN02	2018-02-23 06:14:00	8.3	0.8	RN02	2018-03-16 04:46:48	8.8	0.4
RN02	2018-02-24 06:03:06	8.5	0.0	RN02	2018-03-19 07:25:07	2.2	0.2
RN02	2018-02-25 07:09:24	9.0	0.4	RN02	2018-03-21 04:44:13	9.0	0.3
RN02	2018-02-25 07:10:40	8.7	0.4	RN02	2018-03-21 04:49:01	9.6	0.1
RN02	2018-02-26 06:03:44	10.2	0.2	RN02	2018-03-27 04:46:38	8.9	0.0
RN02	2018-02-27 07:50:03	8.2	-0.2	RN02	2018-03-28 00:16:22	8.0	0.4
RN02	2018-02-27 07:51:56	8.4	0.2	RN02	2018-03-28 04:50:34	8.1	0.0
RN02	2018-02-28 08:03:49	9.0	0.1	RN02	2018-03-28 04:51:43	9.2	-0.2
RN02	2018-03-01 07:51:19	9.1	0.4	RN02	2018-03-28 04:52:44	10.6	0.0
RN02	2018-03-01 07:54:36	8.8	0.0	RN02	2018-03-31 00:25:07	2.7	-0.6
RN02	2018-03-03 05:47:28	9.7	0.0	SG02	2018-01-01 00:07:50	1.9	-0.4
RN02	2018-03-06 05:59:22	9.1	0.5	SG02	2018-01-01 00:12:04	0.9	-0.2
RN02	2018-03-06 06:00:32	8.9	0.6	SG02	2018-01-01 02:19:32	2.3	-0.6
RN02	2018-03-06 06:05:54	8.2	0.4	SG02	2018-01-01 05:31:42	1.5	-0.6
RN02	2018-03-09 07:15:48	8.0	0.6	SG02	2018-01-01 05:56:18	1.2	-0.6
RN02	2018-03-09 07:16:51	9.2	0.4	SG02	2018-01-01 06:05:22	1.0	-0.6
RN02	2018-03-09 07:20:05	9.4	0.4	SG02	2018-01-01 07:38:32	1.3	-0.6
RN02	2018-03-11 02:47:51	8.6	0.6	SG02	2018-01-01 22:49:04	0.8	-0.9
RN02	2018-03-13 04:56:52	8.3	0.1	SG02	2018-01-04 01:38:14	1.8	-0.4
RN02	2018-03-13 04:57:35	8.6	0.2	SG02	2018-01-04 02:55:29	1.5	-0.9
RN02	2018-03-13 04:58:22	9.1	0.2	SG02	2018-03-21 04:38:32	11.2	0.2
RN02	2018-03-13 04:59:09	8.4	0.0				

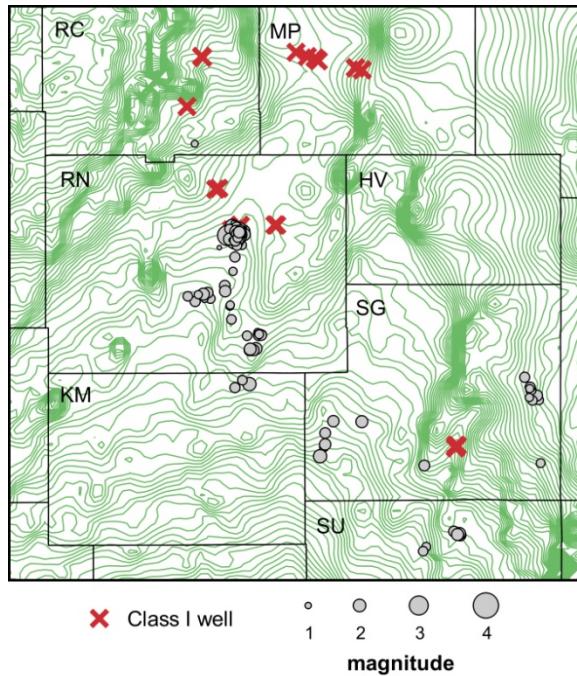


Figure 3. Earthquakes in Figure 2 (gray circles) and Class I wells (red Xs) superimposed on the elevation contours of the top of the Arbuckle Group.

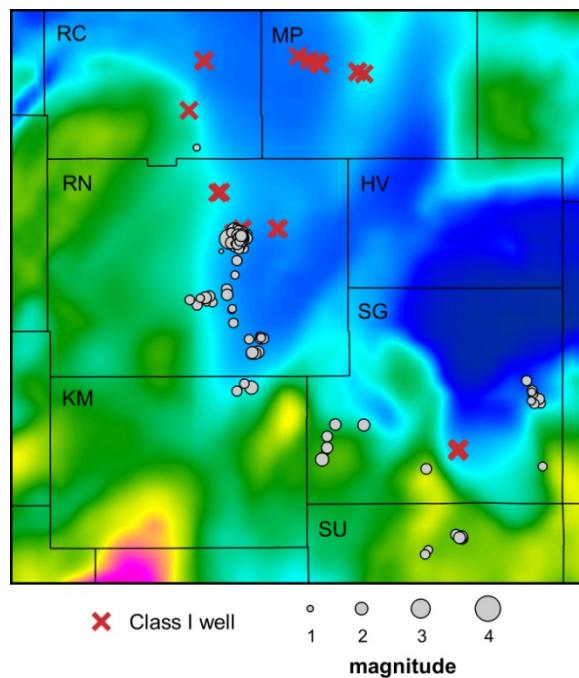


Figure 4. Earthquakes in Figure 2 and Class I wells superimposed on the aeromagnetic map of Kansas.

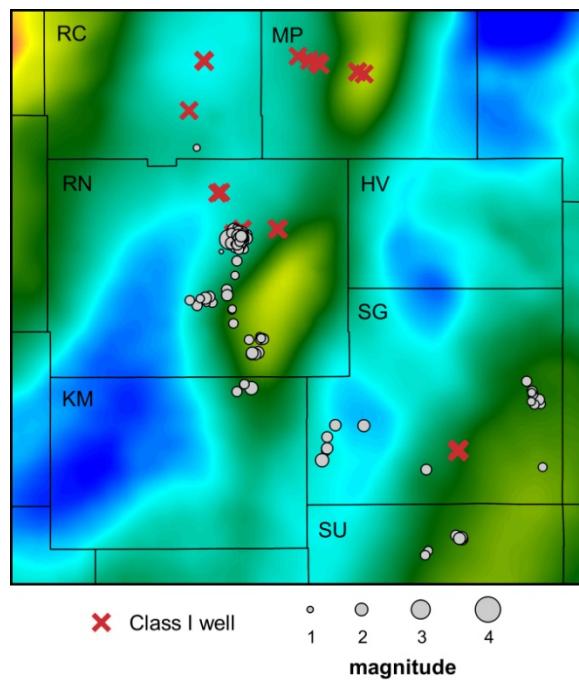


Figure 5. Earthquakes in Figure 2 and Class I wells superimposed on the Residual Bouguer gravity map of Kansas.