Migration of Seismicity from the Mantle to the Upper Crust Beneath Harrat Lunayyir Volcanic Field, Saudi Arabia

Alexander R. Blanchette^{1, 2}, Simon L. Klemperer^{*1}, Walter D. Mooney^{*2}, and Turki A. Sehli³

¹Stanford University ²United States Geological Survey ³Saudi Geological Survey *correspondence: sklemp@stanford.edu, mooneyusgs@gmail.com

Supplementary Materials

Tables S1 and S2 Figure S1

Table S1: Important dates

Date	Event				
Pre-crisis					
1998-05-18	UMJS and YNBS installed				
1998-09-16	First earthquake reported at Harrat Lunayyir Harrat Lunayyir (HL)				
	from local array				
2005-07-01	UMJS and YNBS stop being operational				
2007-08-19	UMJS and YNBS operational again				
2007-09-16	2007–2008 Seismicity begins				
2008-05-05	2007–2008 Seismicity ends				
Crisis					
2009-04-18	2009 Crisis seismicity begins				
2009-06-19	Ground deformation no longer detectable via InSAR				
Post-crisis					
2010-07-26	Stable detection threshold achieved, and mantle seismicity				
	regularly detected				
2012-04-23	Final seismographic station installed at HL				
2022-05-31	End of seismic catalog				

ID	Start	End	N_{eq}	M_{max}	$M_0 (10^{11} \text{ N-m})$	Duration (Days)	Eqs/Day
1	2011-09-28 00:38:25	2011-10-02 01:19:33	90	1.9	33.9	4.0	22
2	2011-10-22 22:57:47	2011-10-26 01:49:26	8	1.3	2.2	3.1	3
3	2012-01-21 07:32:12	2012-01-25 03:58:39	35	1.4	9.3	3.9	9
4	2012-06-20 19:03:33	2012-06-22 03:11:07	21	1.7	13.2	1.3	16
5	2012-08-12 15:11:25	2012-08-13 17:45:19	12	2.0	16.8	1.1	11
6	2012-10-26 20:51:18	2012-10-27 06:15:18	3	0.9	0.6	0.4	8
7	2013-05-20 02:50:23	2013-05-20 05:57:46	4	1.2	1.3	0.1	31
8	2013-09-02 13:10:32	2013-09-05 04:22:01	91	1.7	28.7	2.6	35
9	2014-01-13 16:07:01	2014-01-13 17:11:44	3	1.1	1.0	0.0	67
10	2014-05-03 07:41:11	2014-05-08 21:44:41	28	1.5	8.4	5.6	5
11	2015-03-11 18:53:52	2015-03-12 01:03:54	3	0.8	0.4	0.3	12
12	2015-05-21 21:26:37	2015-05-24 00:04:03	16	2.1	27.2	2.1	8
13	2016-01-21 00:32:14	2016-01-24 16:18:07	56	2.1	31.3	3.7	15
14	2016-07-05 22:28:15	2016-07-14 06:26:51	37	1.6	11.7	8.3	4
15	2016-09-25 19:42:31	2016-09-26 08:50:00	7	0.8	0.9	0.5	13
16	2016-10-26 21:50:04	2016-10-29 16:11:54	18	1.2	4.6	2.8	7
17	2018-07-25 20:05:33	2018-08-02 00:35:38	143	2.1	79.9	7.2	20
18	2018-09-30 06:56:12	2018-09-30 18:46:41	4	1.6	3.4	0.5	8
19	2018-10-29 20:02:47	2018-10-30 04:34:38	4	1.2	1.4	0.4	11
20	2018-11-16 16:53:43	2018-11-16 22:48:51	8	1.2	1.7	0.2	32
21	2019-05-17 00:20:44	2019-05-17 01:18:00	3	1.1	0.7	0.0	75
22	2020-11-25 00:51:20	2020-12-09 21:50:27	516	2.2	309.0	14.9	33
23	2020-12-21 15:15:19	2020-12-28 05:57:54	439	2.1	365.9	6.6	66
24	2021-10-14 21:12:33	2021-10-15 04:02:30	4	1.0	1.1	0.3	14

Table S2: Mantle Earthquake Sequences

Figure S1.

Daily plots of seismicity during the 2009 intrusion episode from 19 April 2009–30 May 2009. Each row a–f is a week (6 weeks total). Each image is a day (7 days a week). Time increases from left to right and top to bottom (e.g., day 1 is a1, day 42 is f7). Rows a–e correspond to Figure 6a–e.



- 10^(m) 15 - 15 - 20 - 25

0 5

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