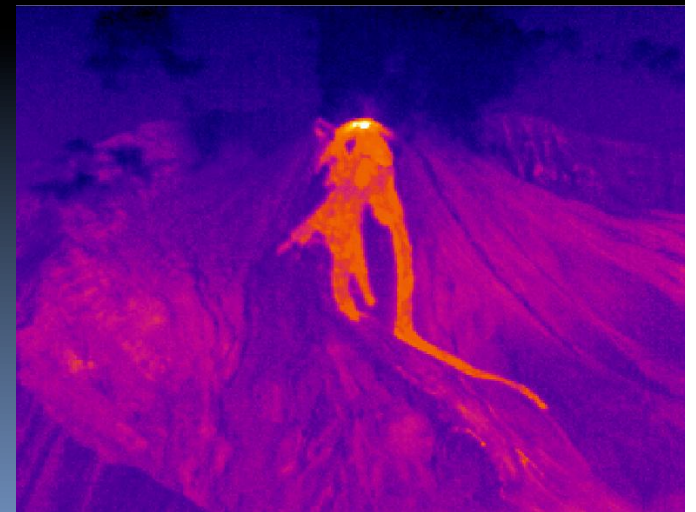


Thermal monitoring in volcanoes on Ecuador

Instituto Geofísico
Escuela Politécnica Nacional

PASI 2011 Workshop – San José, Costa Rica

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Thermal Monitoring

- Active and dangerous continental and island volcanoes in Ecuador
- Useful, safe and give a real view of the external temperature
- One FLIR ThermoCAM™ PM695, (2002)
- Complementary monitoring
- From the air and land if it is possible



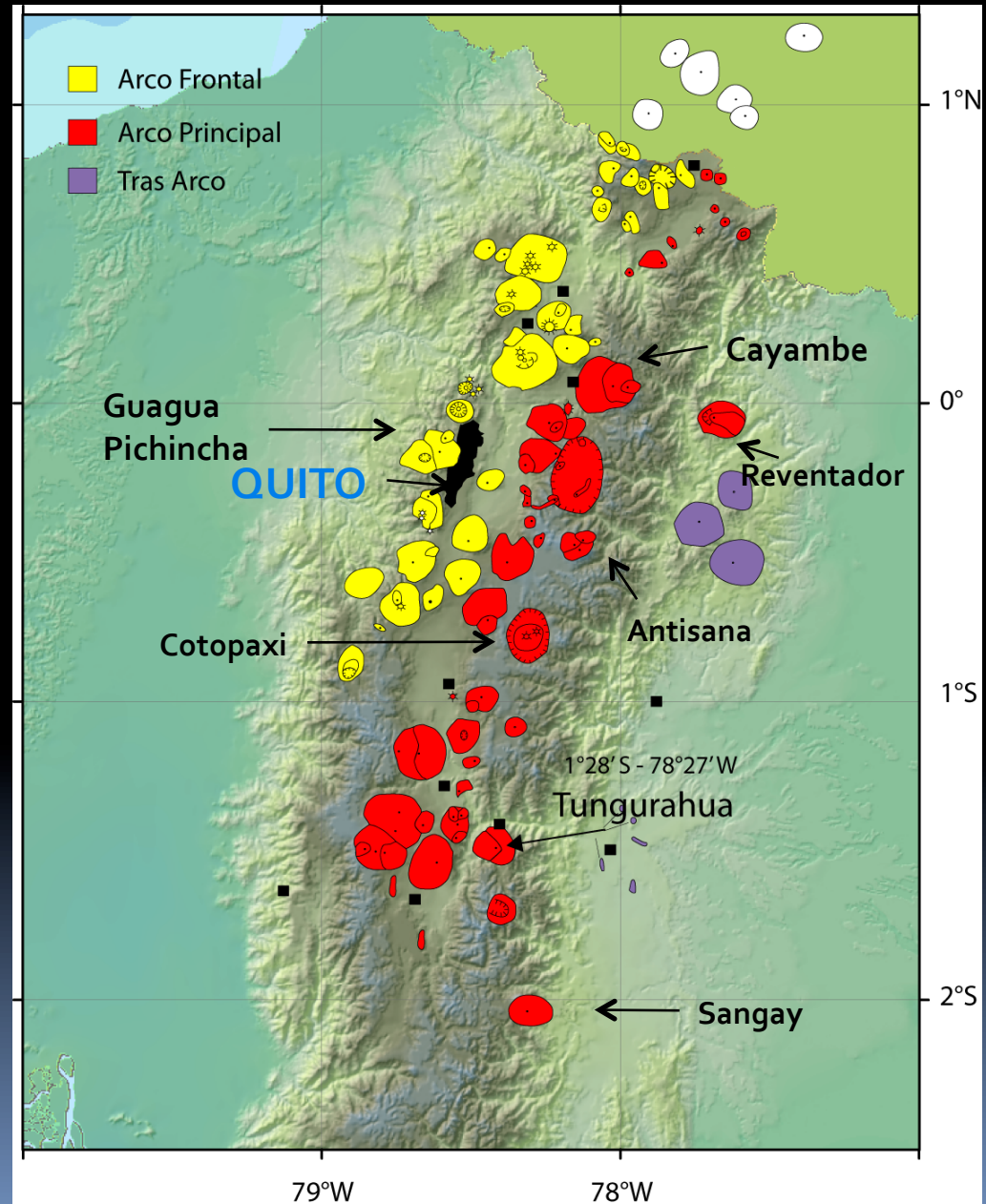
Thermal Monitoring

- Continue monitoring of seven active continental volcanoes with/without superficial activity
- Effusive activity (Reventador, Tungurahua)
 - lava flows distribution
- Explosive activity (Tungurahua, Reventador)
 - Pf's dynamics
 - Incandescent blocks distributions in the flanks



Thermal monitoring in active ecuadorian volcanoes:

- ❖ Cayambe
- ❖ Reventador
- ❖ Guagua Pichincha
- ❖ Antisana
- ❖ Cotopaxi
- ❖ Tungurahua
- ❖ Sangay



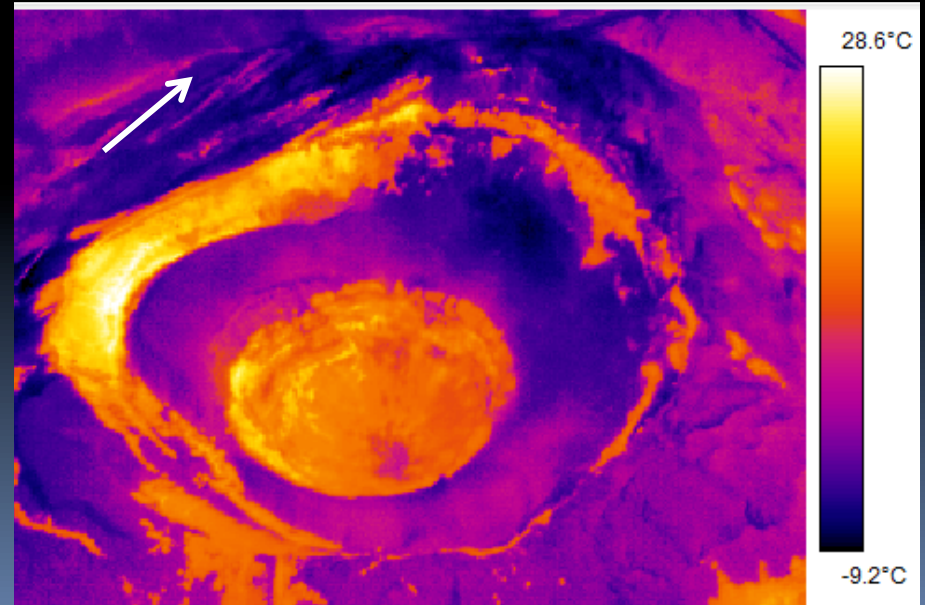
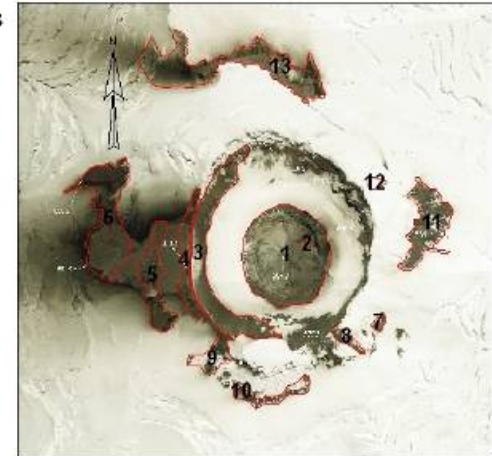


Cotopaxi

- 5897 masl
- Increase seismic activity from 2001

ESQUEMA DE LAS ZONAS ANALIZADAS EN VOLCAN COTOPAXI

Id.	Zonas analizadas
1	Cráter Interno
2	Cráter Interno F. E.
3	Anillo Arena Interno
4	Anillo Arena Externo
5	Flanco Occidental 2
6	Flanco Occidental 1
7	Flanco Sur 1
8	Flanco Sur 2
9	Flanco Sur 3
10	Flanco Sur 4
11	Flanco Oriental 1
12	Flanco Oriental 2
13	Yanesacha





Reventador Volcano

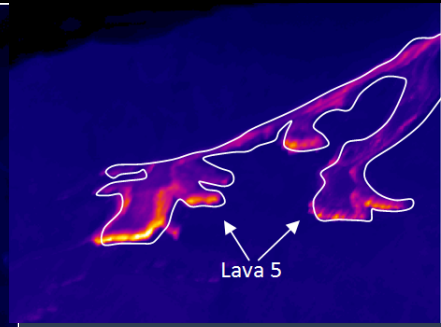
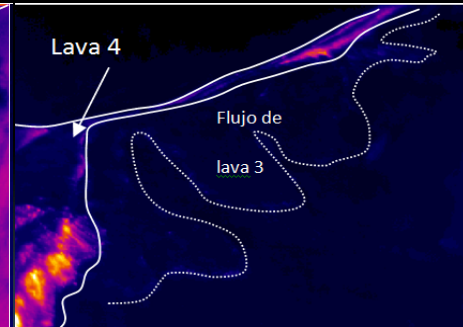
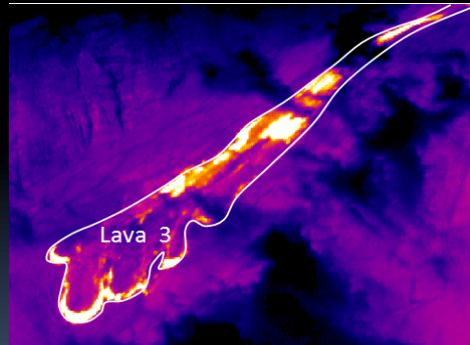
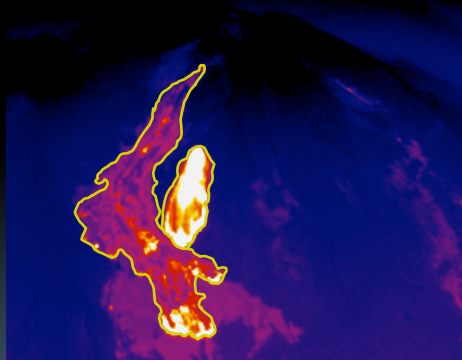


- 3485 masl
- Strato volcano
- Conic shape
- Big eruption 2002

- Latest eruptions:
 - June 2008
 - November 2008
 - November 2009



Reventador lava flows 2002 - 2005



Lava flow 1 and 2
2002

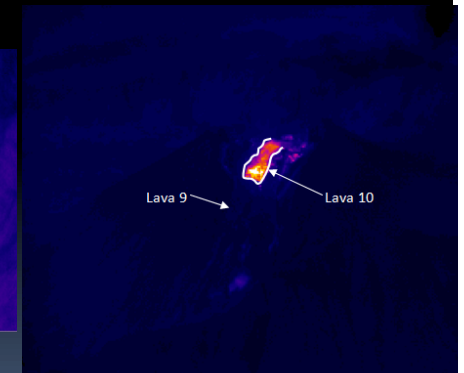
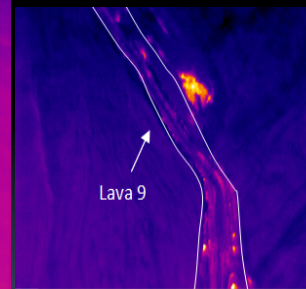
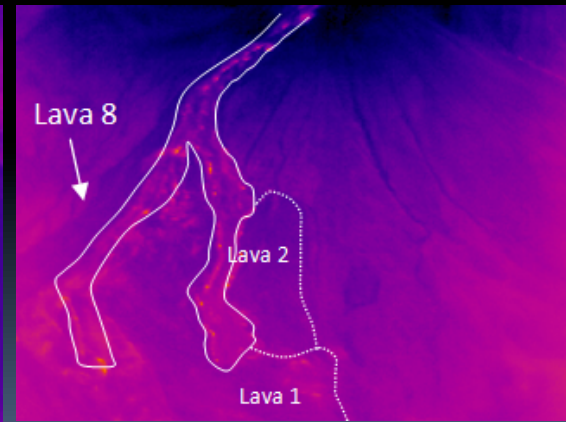
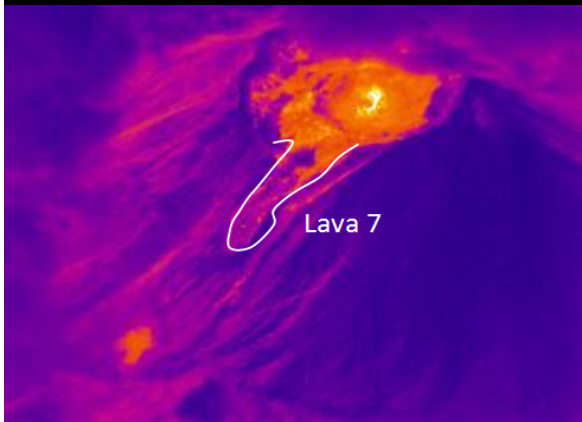
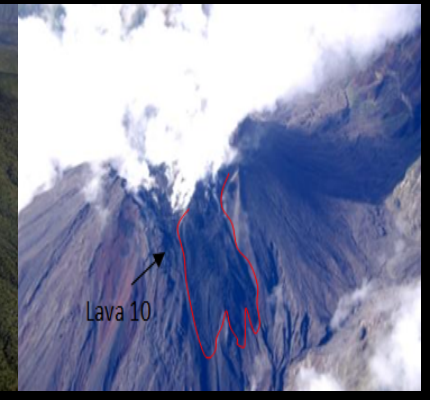
Lava flow 3
2004

Lava flow 4
2005

Lava flow 5
2005



Reventador lava flows 2005 - 2007



Lava flow 7
2005

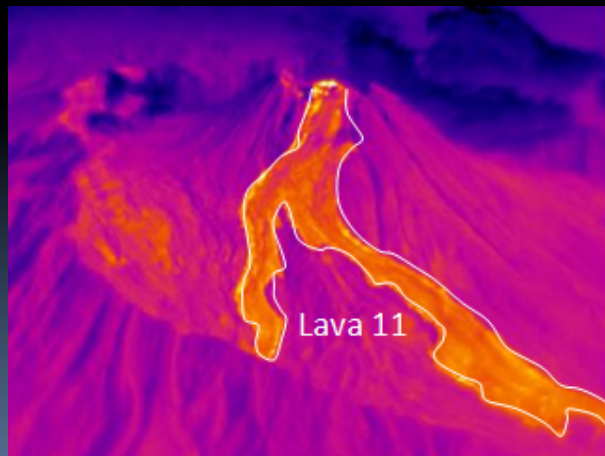
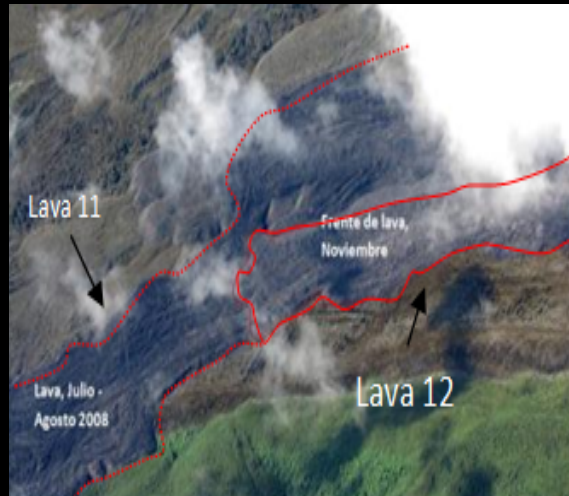
Lava flow 8
2007

Lava flow 9
2007

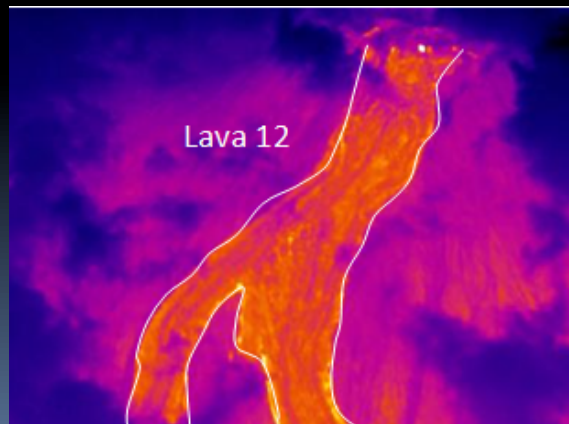
Lava flow 10
2007



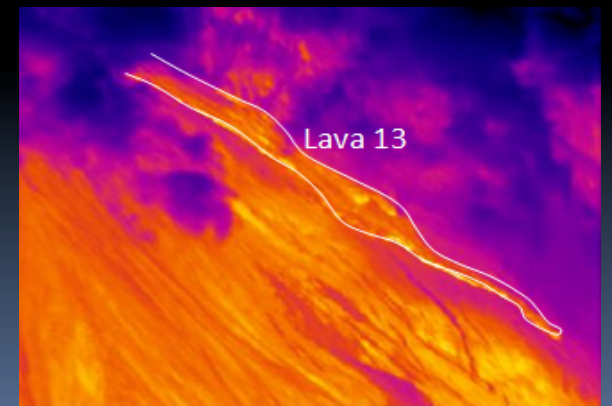
Reventador lava flows 2007 - 2009



Lava flow 11
2008



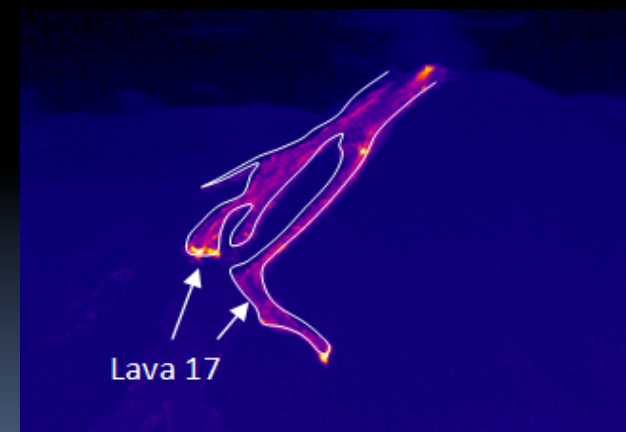
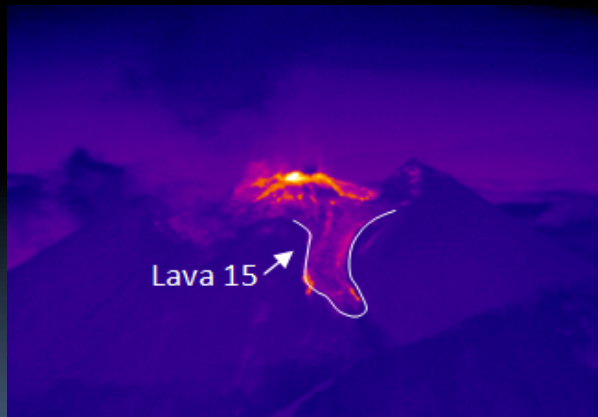
Lava flow 12
2008



Lava flow 13
2008



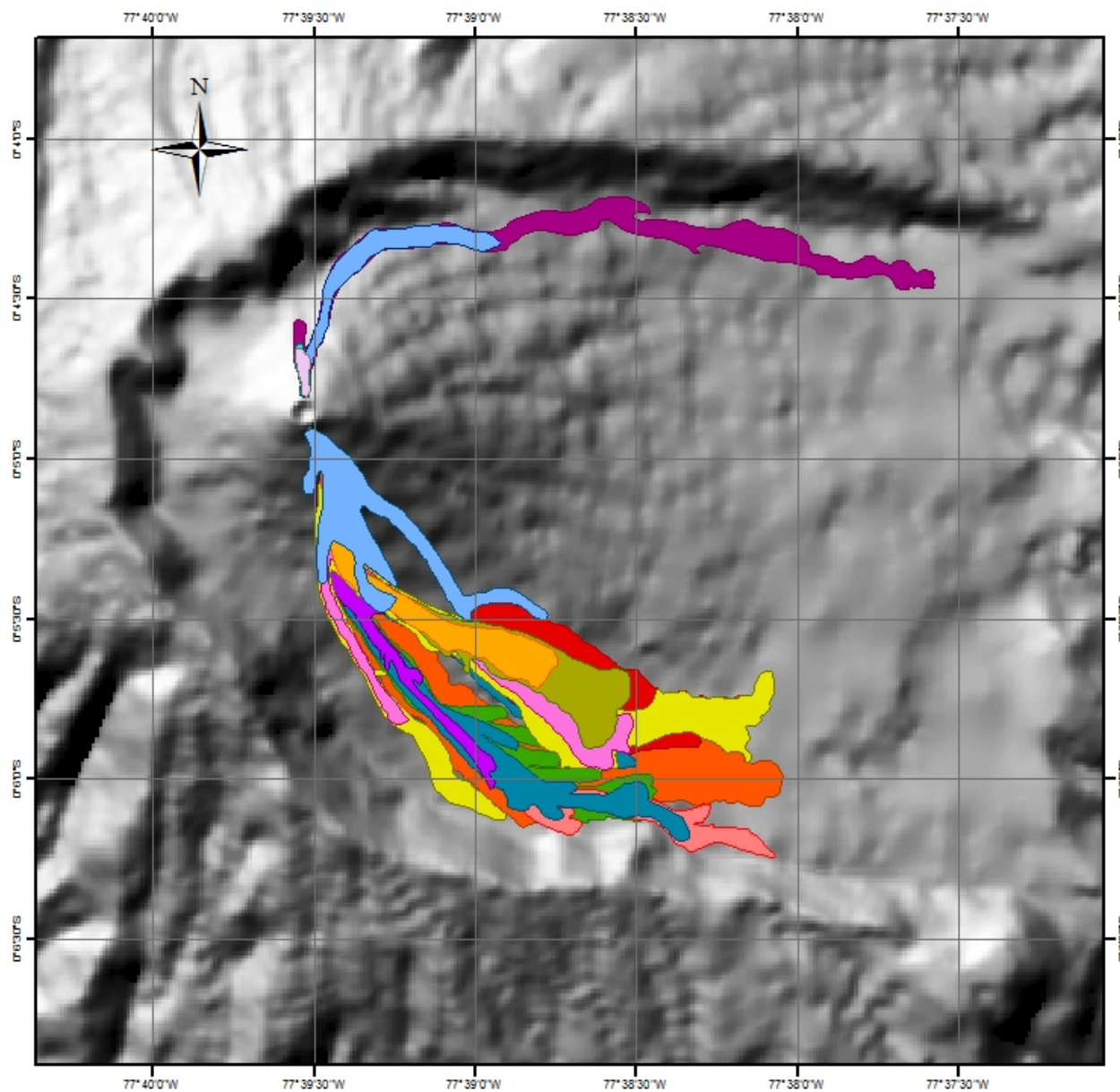
Reventador lava flows 2007 - 2009



Lava flow 15
2009

Lava flow 17
2009

REVENTADOR VOLCANOE LAVA FLOW 2002 - 2009



- Legend**
- Lava Flow 17 (S) 2009 - 10
 - Lava Flow 16 (S) 2009 - 08
 - Lava Flow 15 (N) 2009 - 04
 - Lava Flow (S) 2009 - 04
 - Lava Flow 13 (N) 2008 - 11
 - Lava Flow 12 (S) 2008 - 11
 - Lava Flow 11 (S) 2008 - 07
 - Lava Flow 10 (N) 2007 - 08
 - Lava Flow 9 (N) 2007 - 05
 - Lava Flow 8 (S) 2007 - 04
 - Lava Flow 7 (N) 2005 - 11
 - Lava Flow 6 (S) 2005 - 09
 - Lava Flow 5 (S) 2005 - 06
 - Lava Flow 4 (S) 2005 - 04
 - Lava Flow 3 (S) 2004 - 12
 - Lava Flow 2 (SE) 2002 - 11
 - Lava Flow 1 (S) 2002 - 11



Reventador: Mapping lava flows results

Lava flow names	Extent (km)	Area (m ²)	Volume (m ³)
Lava flow 1	3,9	1'223.647	18'354.712
Lava flow 2	1,5	581.778	8'726.680
Lava flow 3	3,2	579.357	8'690.364
Lava flow 4	4,1	444.303	6'664.551
Lava flow 5	3,5	787.299	11'809.492
Lava flow 6	1,3	55.852	837.786
Lava flow 7	0,2	12.343	185.158
Lava flow 8	2,8	464.574	6'968.611
Lava flow 9	4,3	508.675	7'630.138
Lava flow 10	0,2	21.788	326.820
Lava flow 11	3,8	1'000.599	15'008.994
Lava flow 12	2,7	490.976	7'364.644
Lava flow 13	1,7	154.374	2'315.610
Lava flow 14	2,6	483.261	7'248.918
Lava flow 15	0,2	169.65	254.478
Lava flow 16	2,1	280.154	4'202.319
Lava flow 17	1,7	331.961	4'979.422

During 2002 – 2009:

- Area covered by lava flows = 7.44 km²
- Estimated volume ~ 0.11 km³
- Emission rate ~ 1.5 x 10⁷ m³/year (0,5 m³/sec)

During 2002 – 2009:

- Longest lava flows: 4.3 km (Lava 9/2007), 4.1 km (Lava 4/2004)
- Largest lava flows: 18M m³ (Lava 1/2002), 15M m³ (Lava 11/2008)

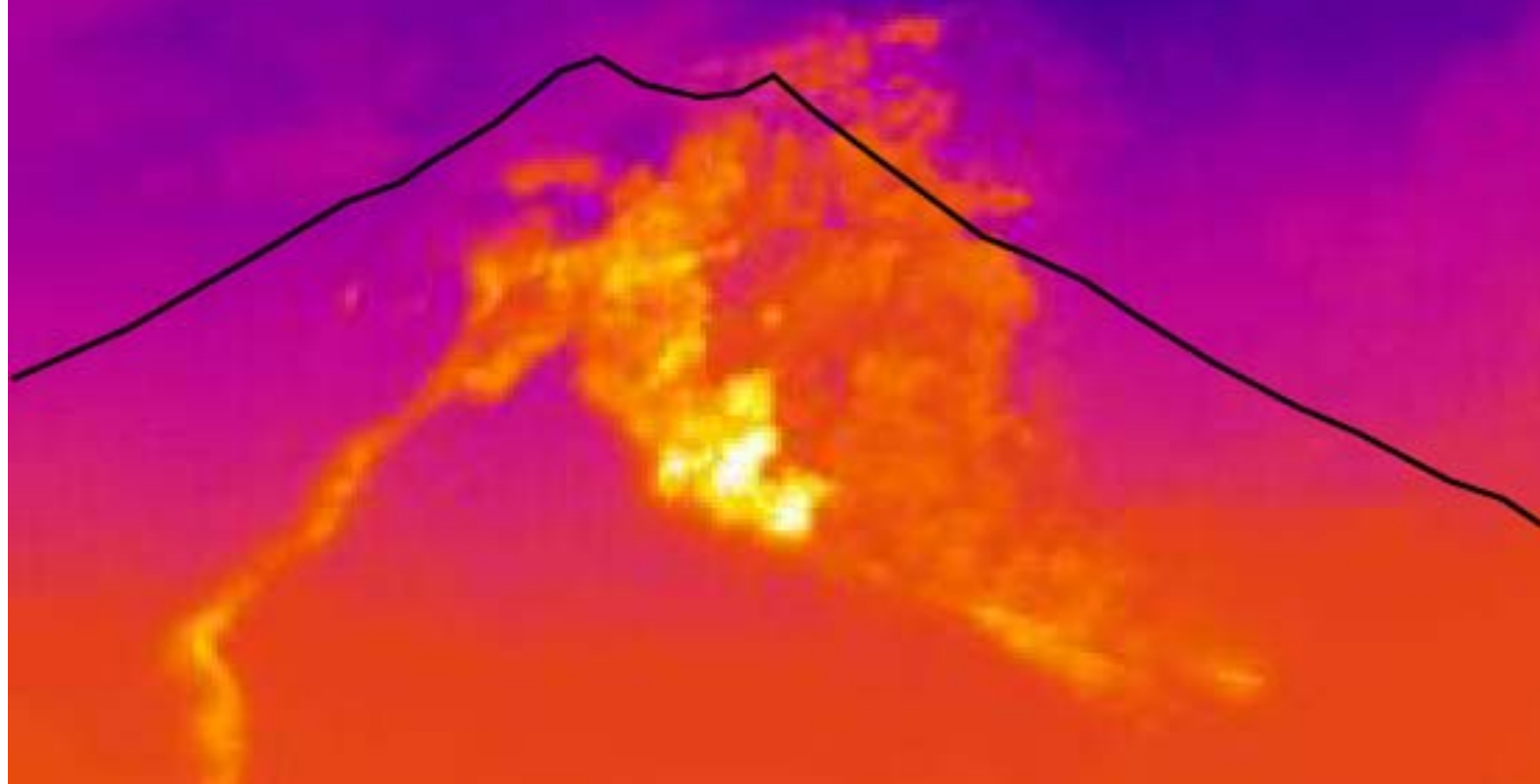


Tungurahua Volcano

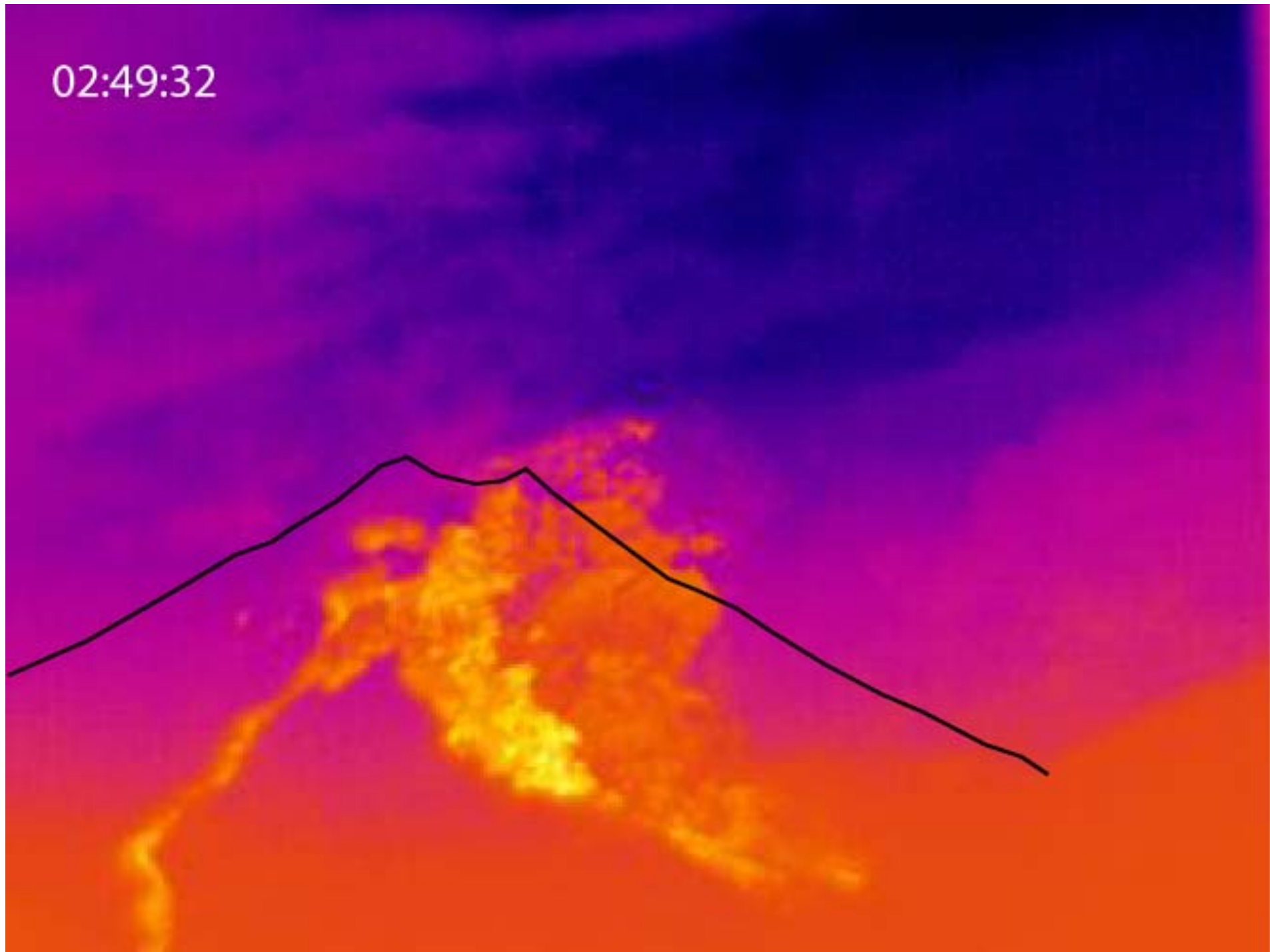
- Strato volcano
- 5023 masl
- Latest eruptions (2006, 2008, 2010):
 - Ash fall
 - Piroclastic flows
 - Surges
 - Lava flows

02:49:28

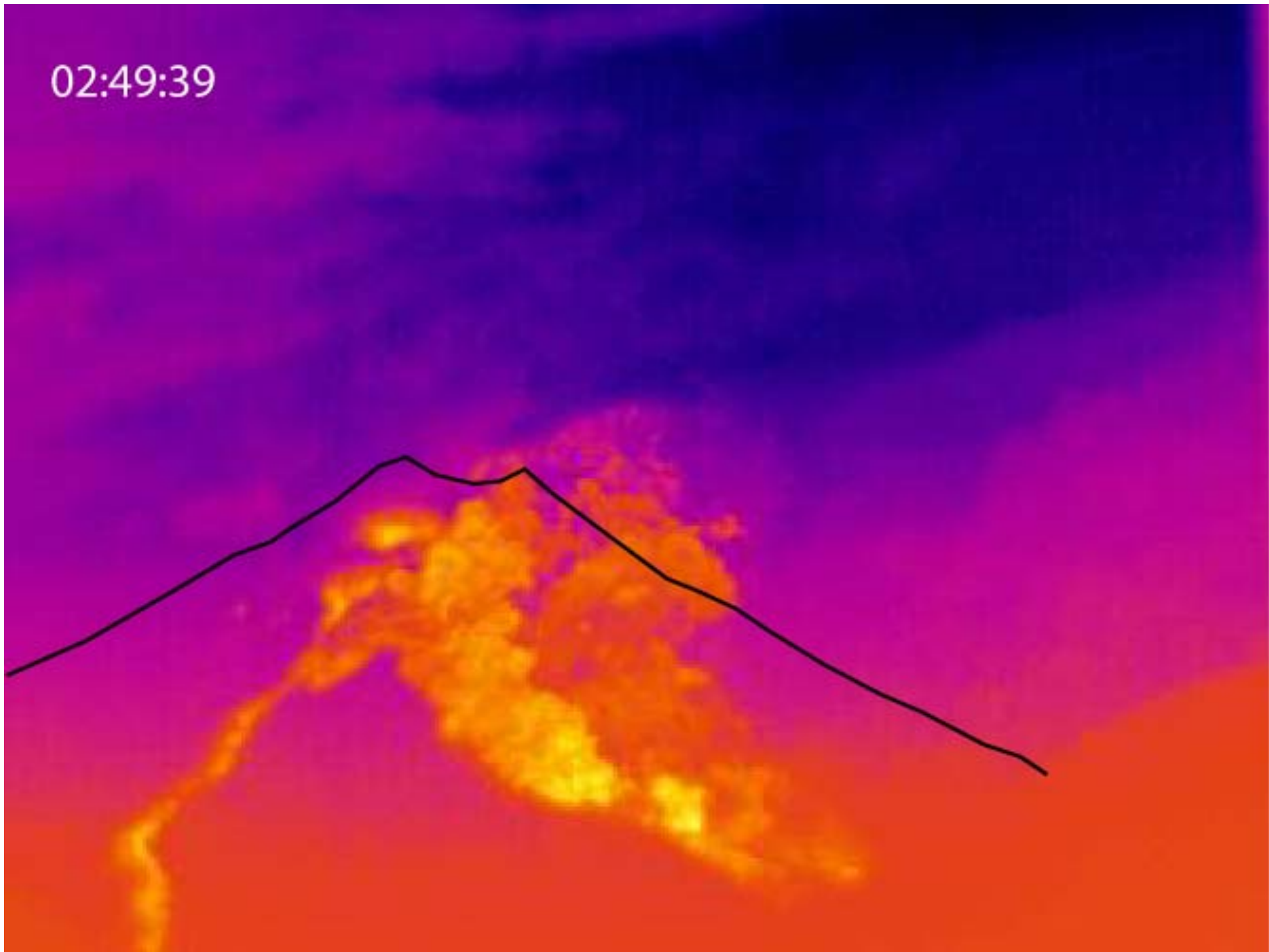
Flujo Piroclástico hacia CUSUA
Registro de 8'15"



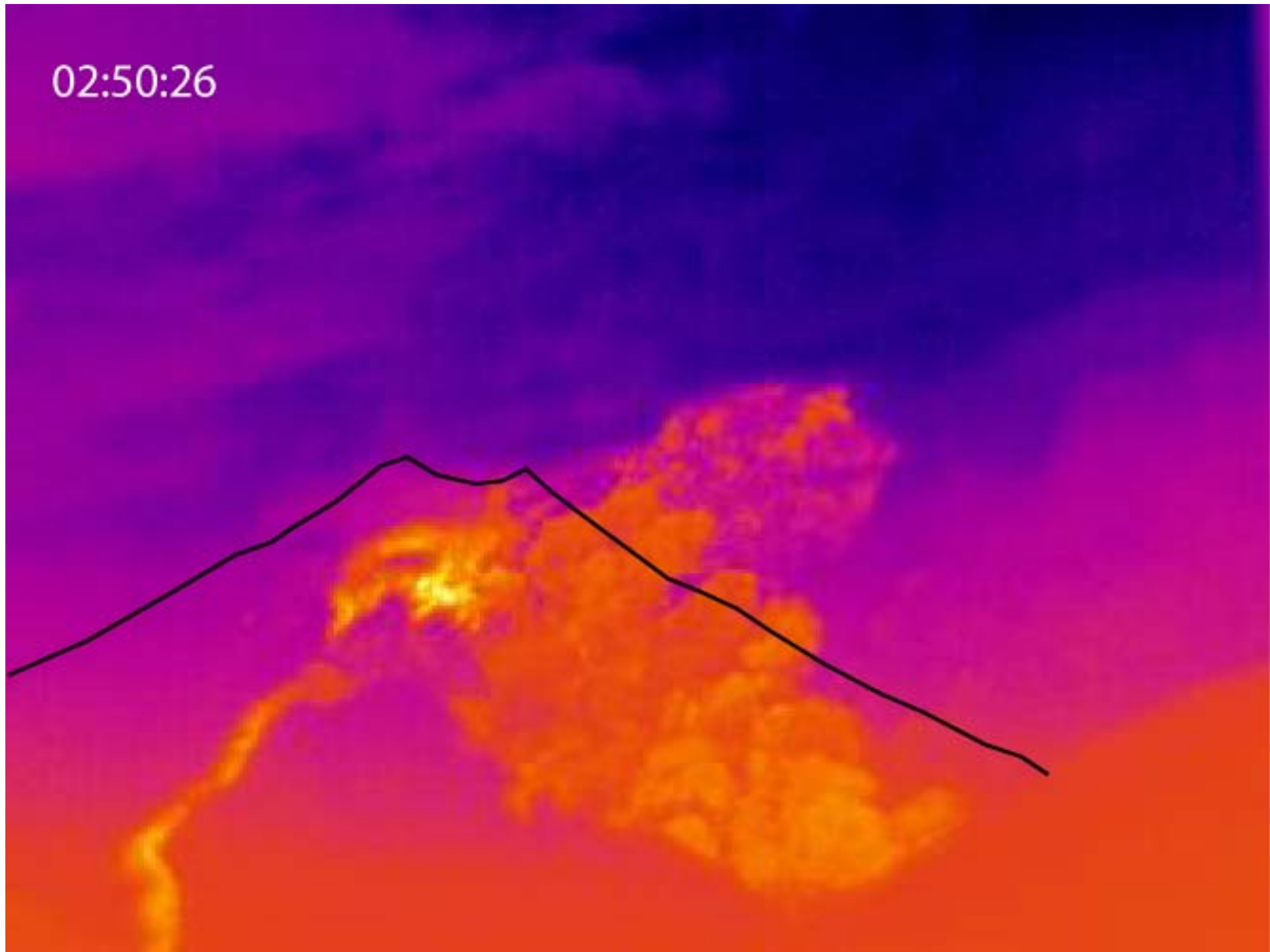
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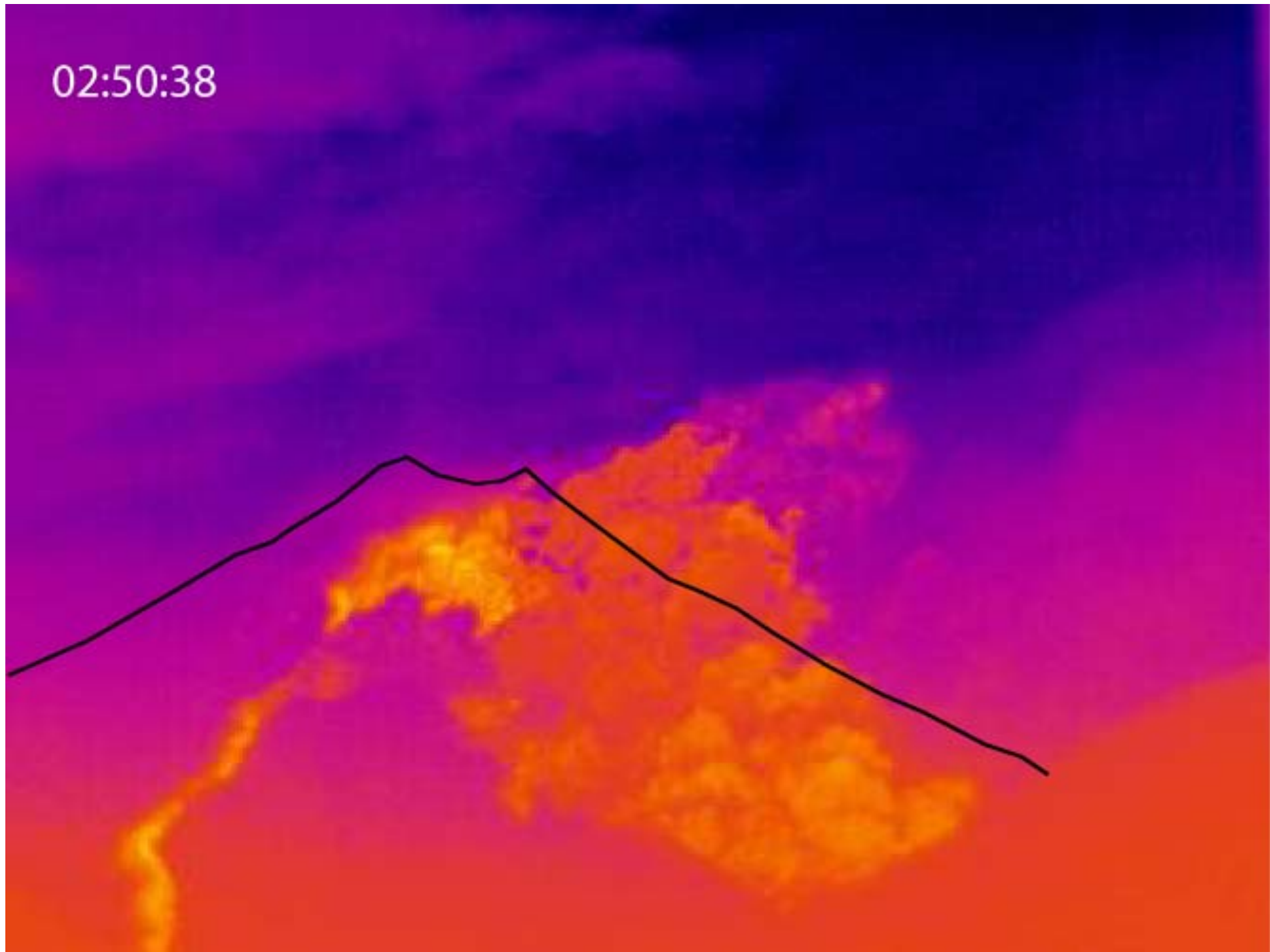
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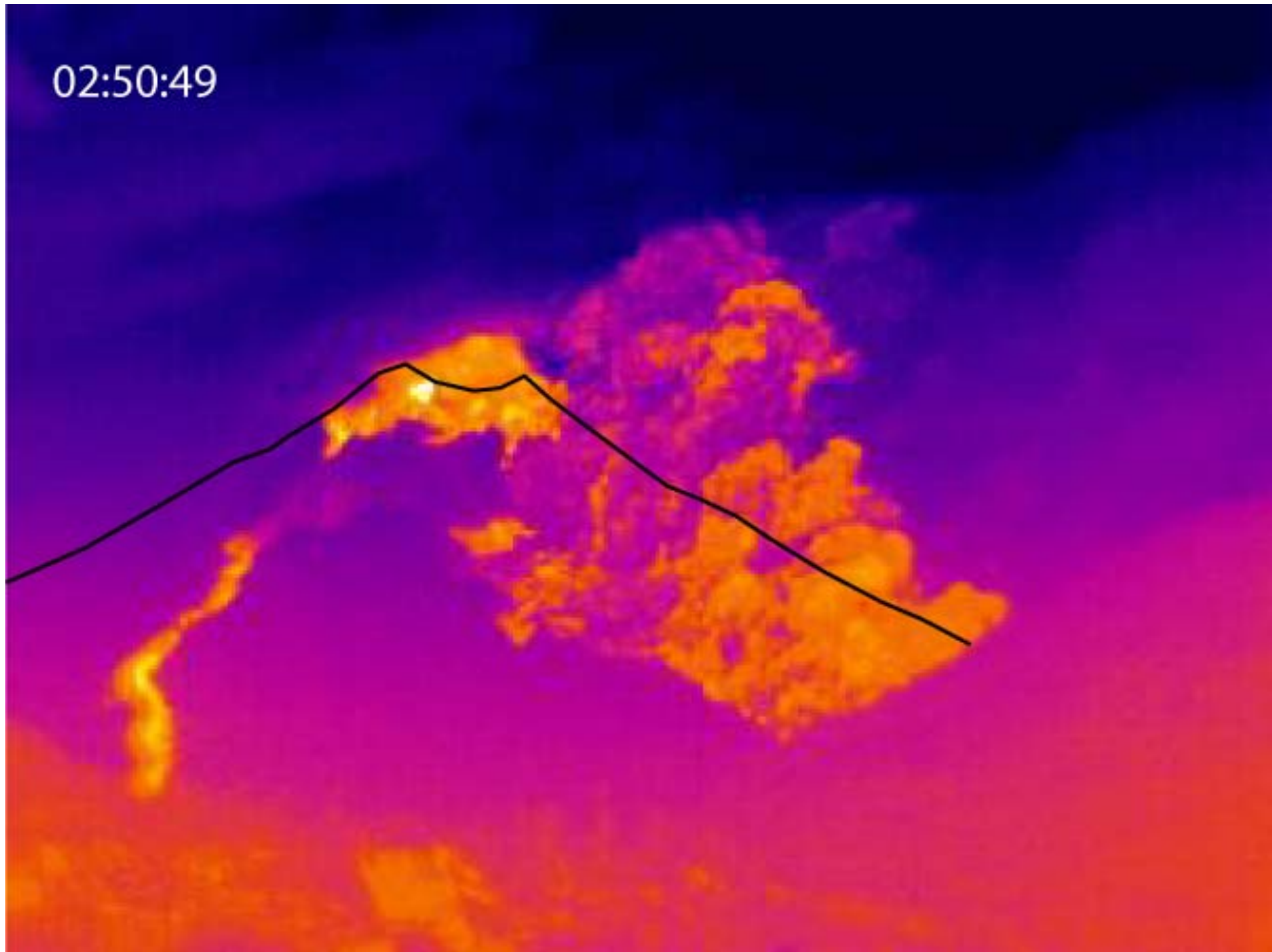
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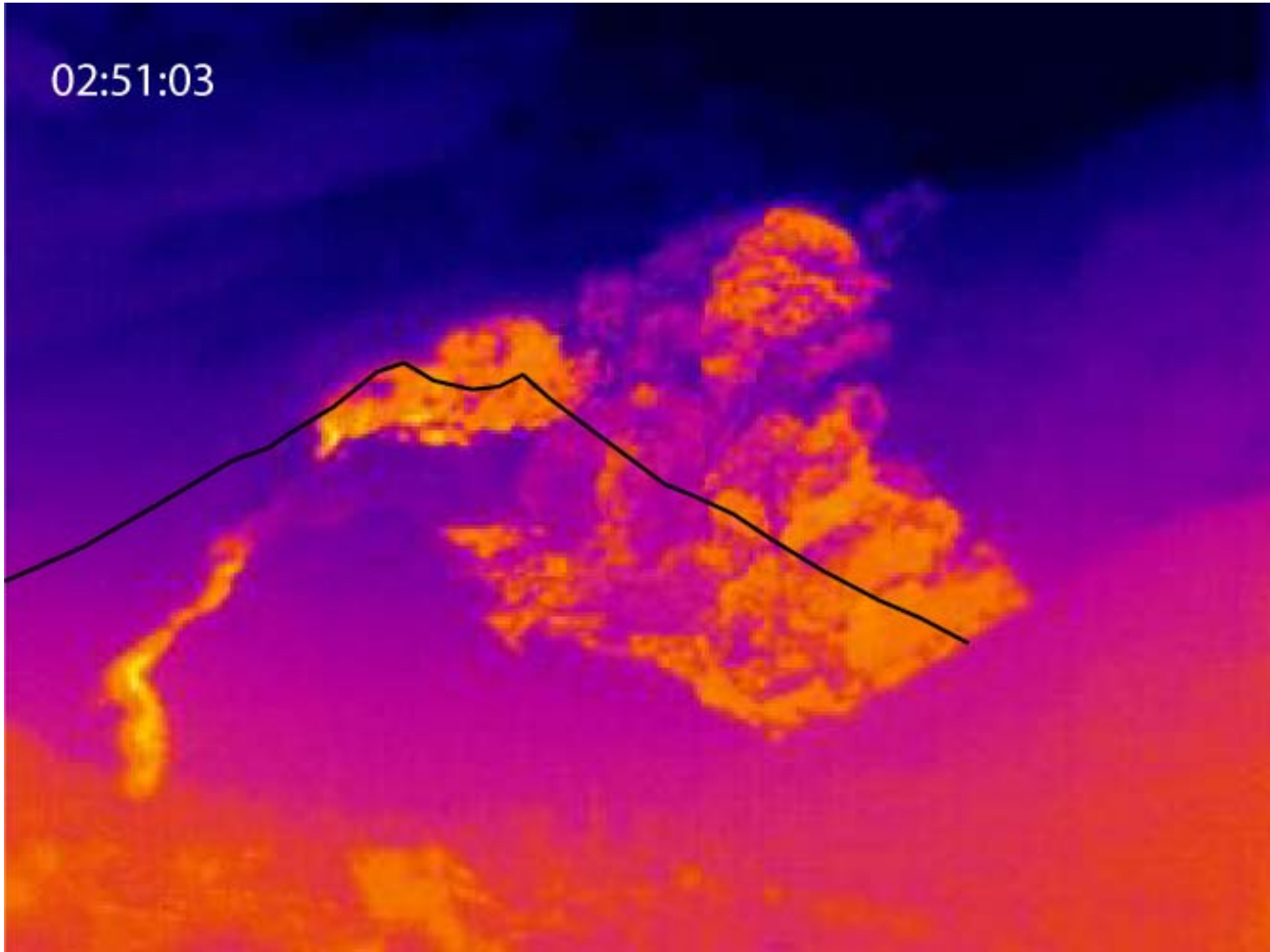
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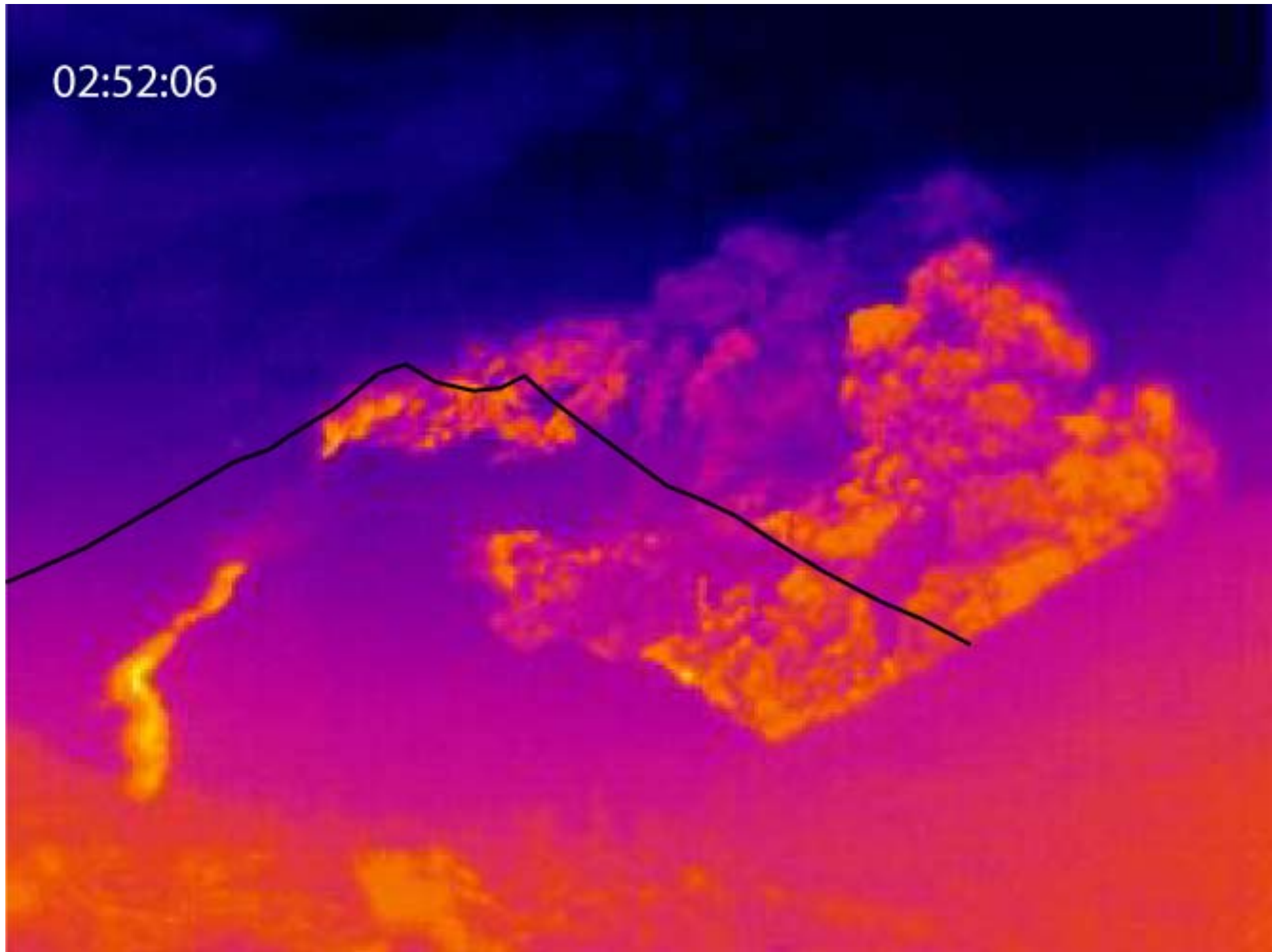
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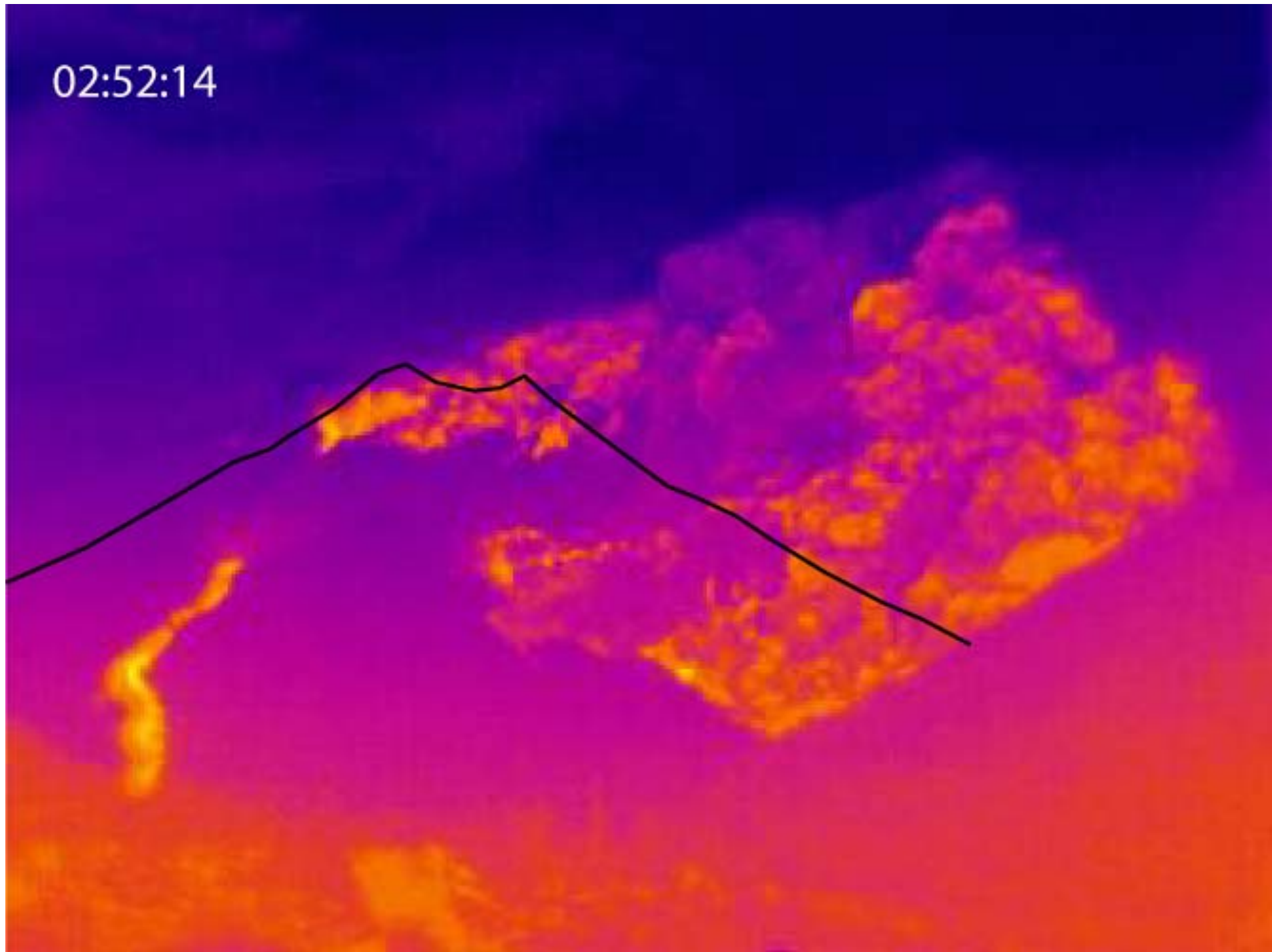
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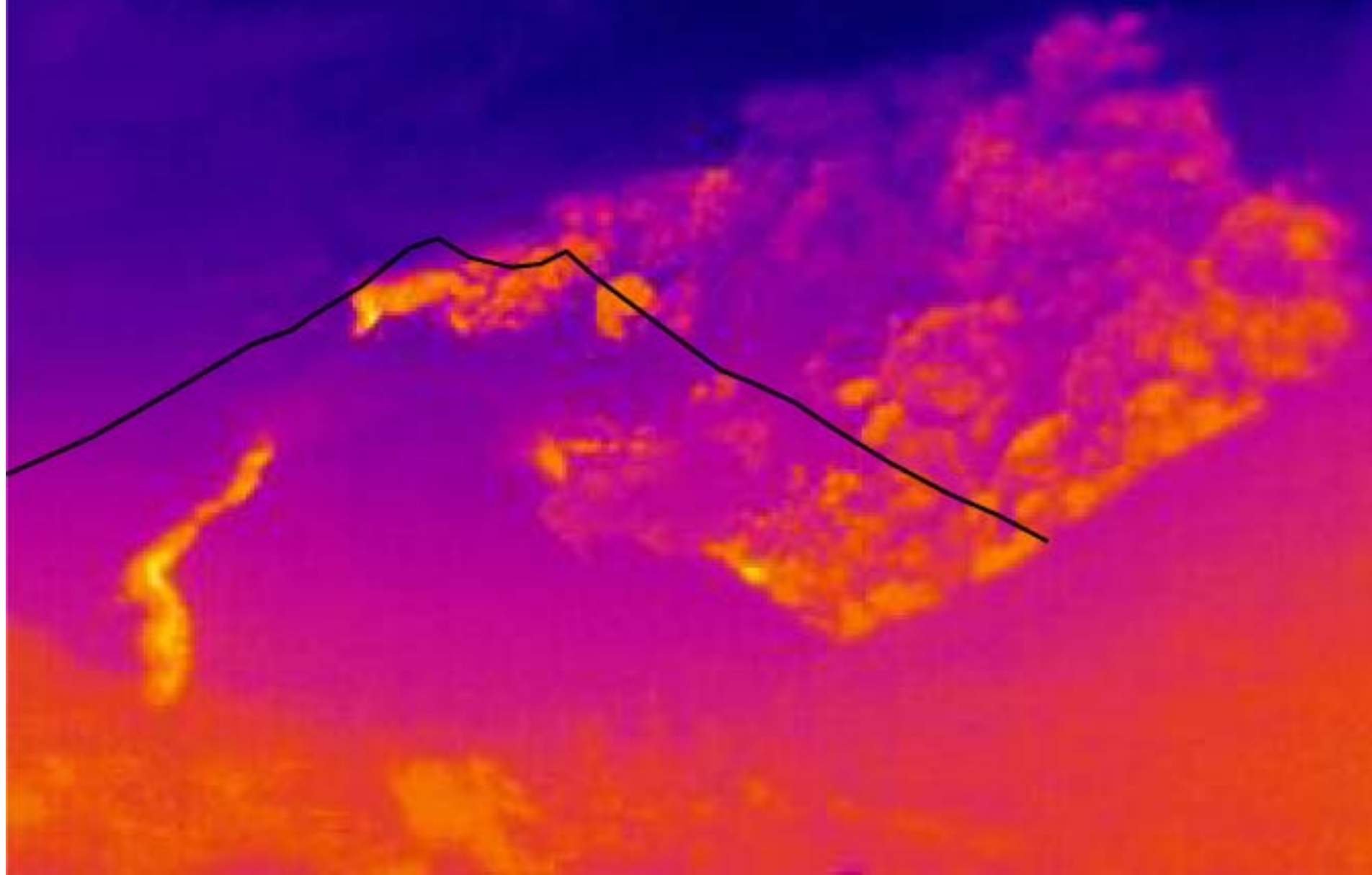
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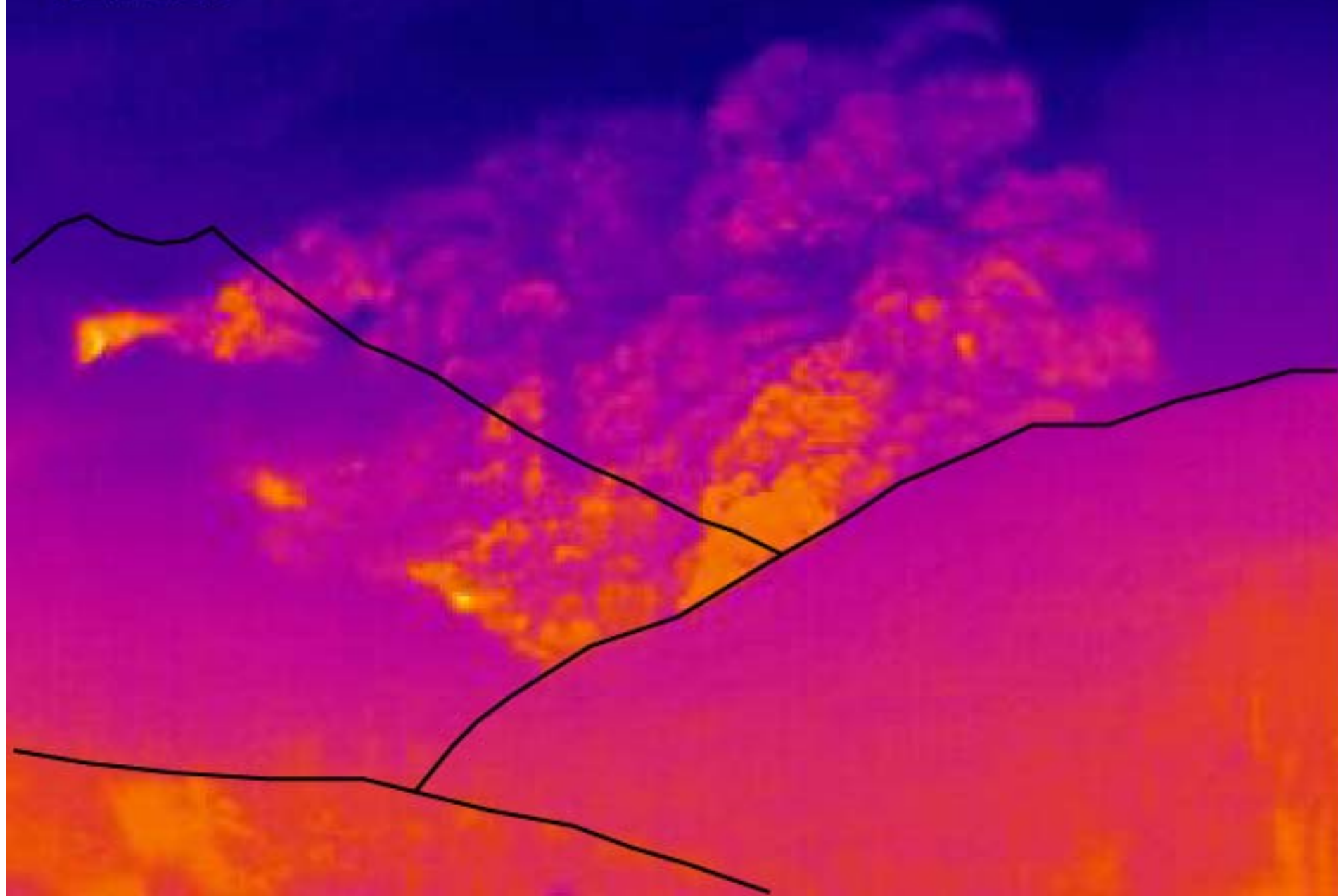
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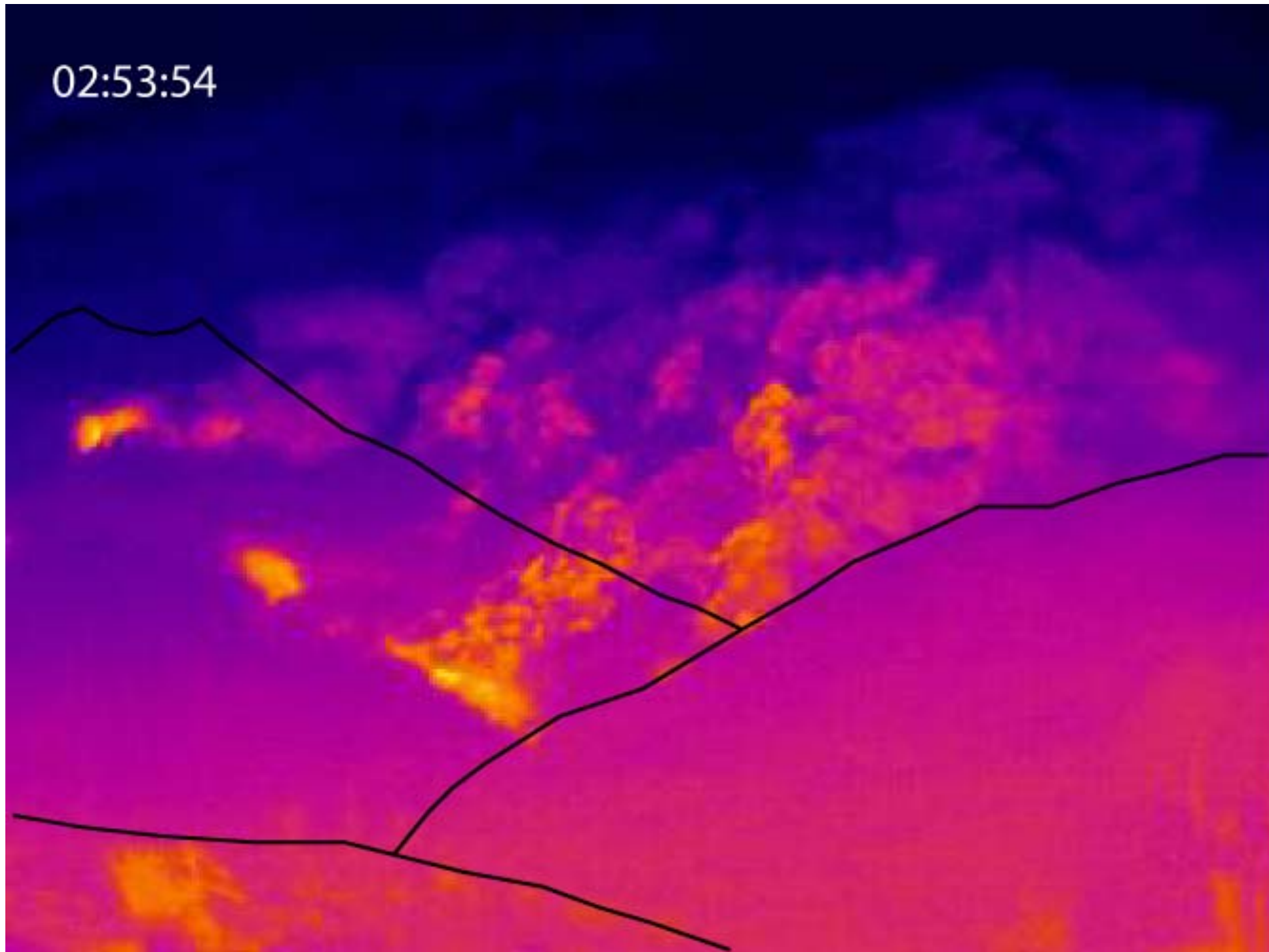
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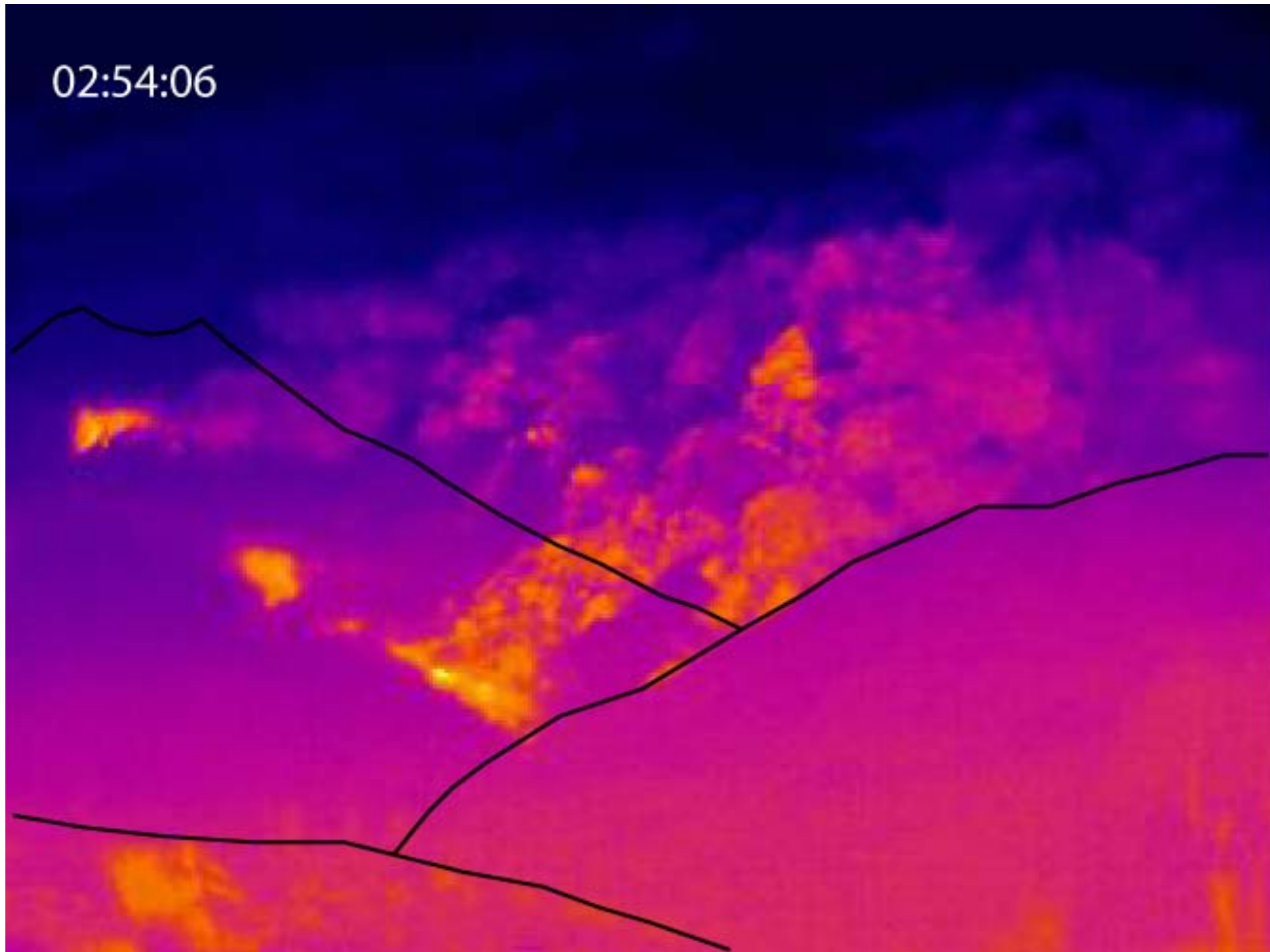
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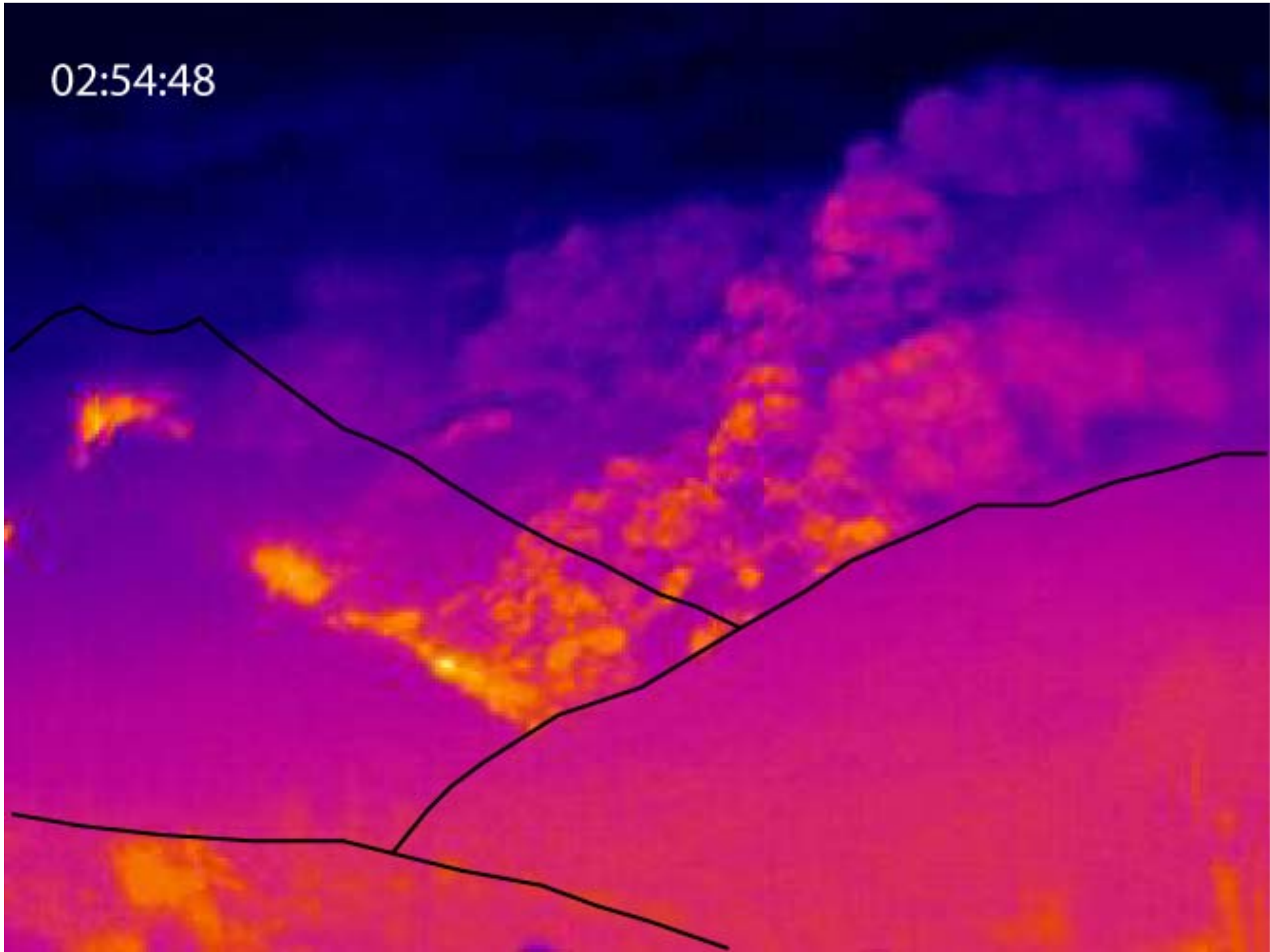
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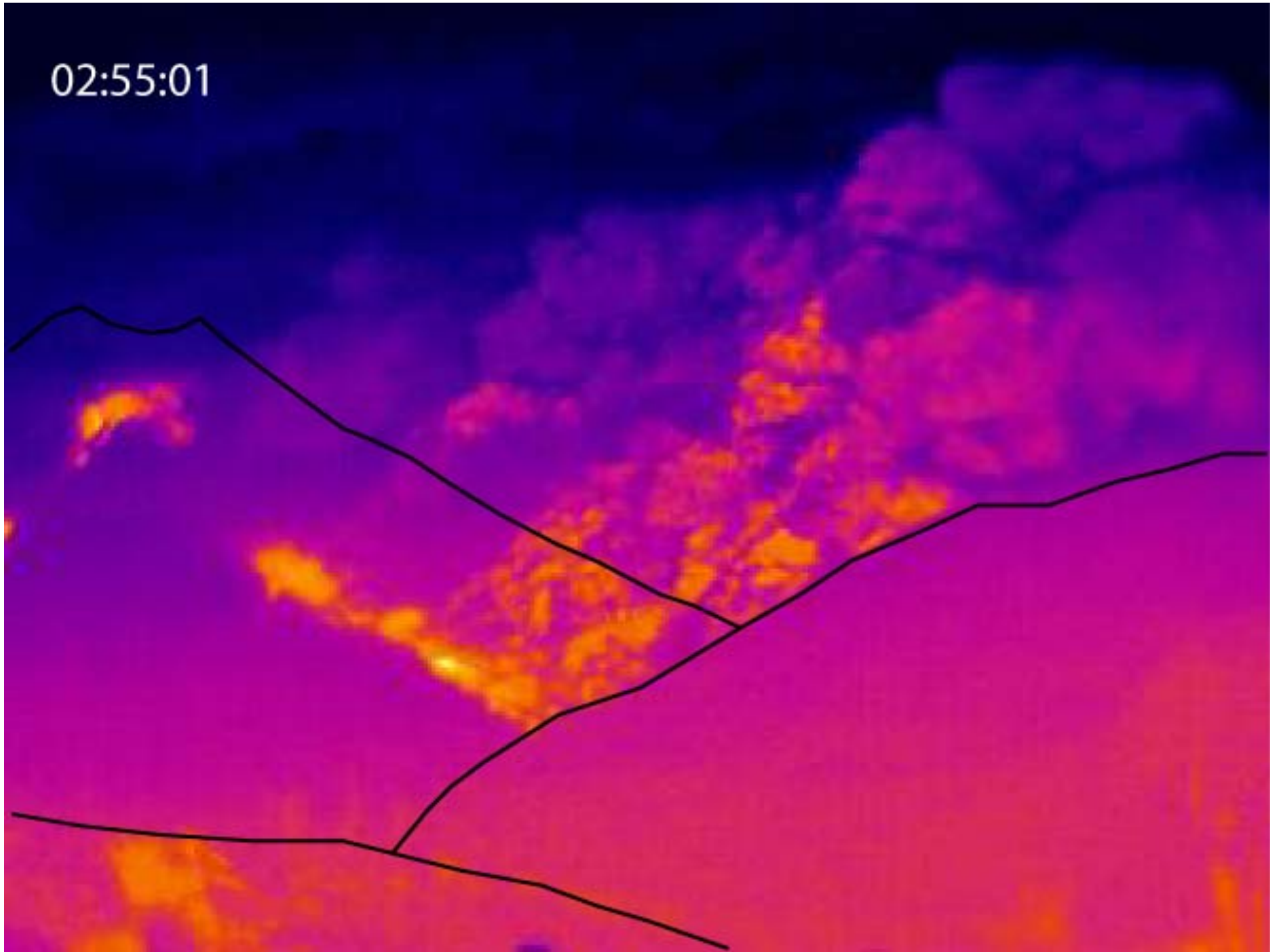
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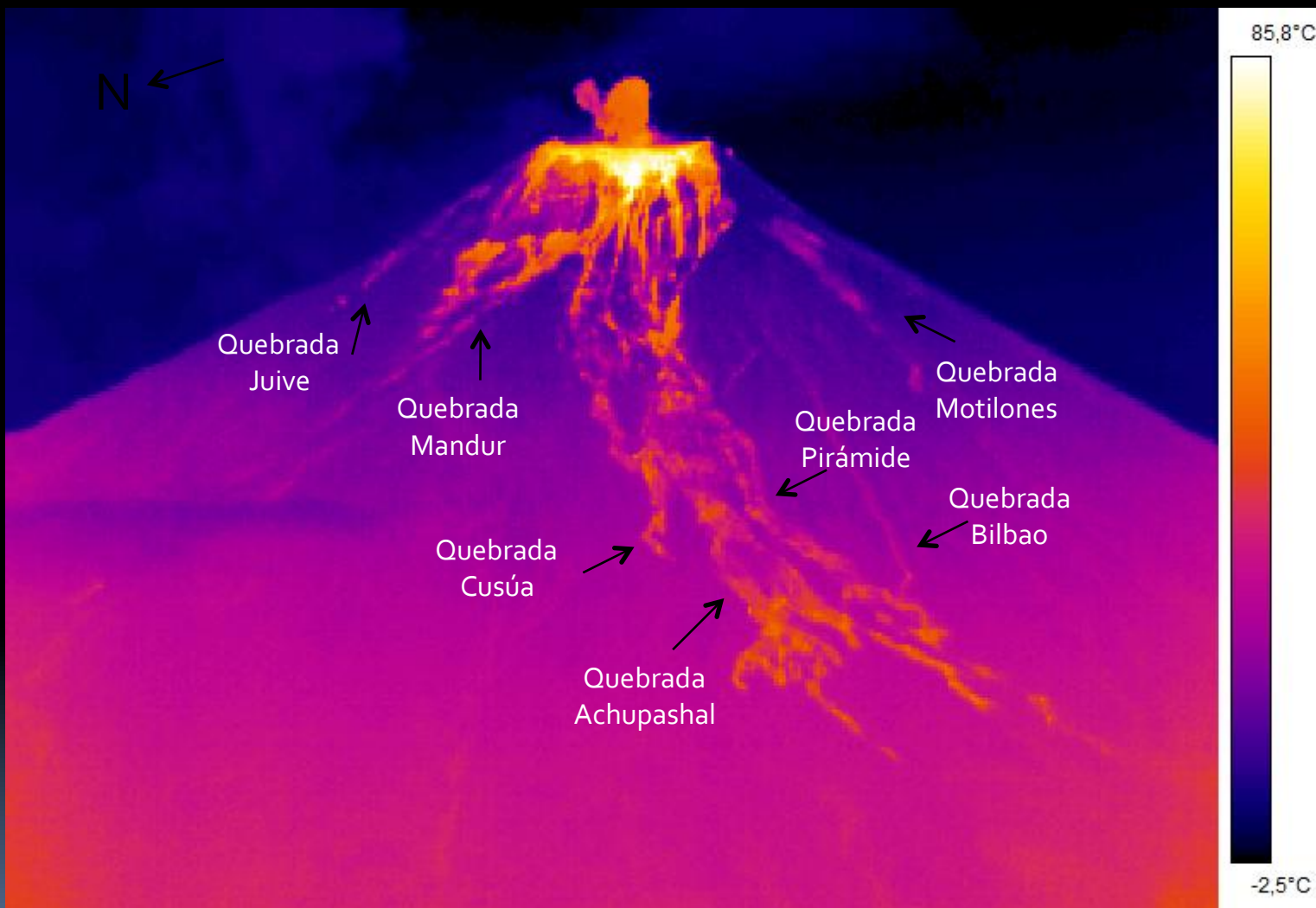
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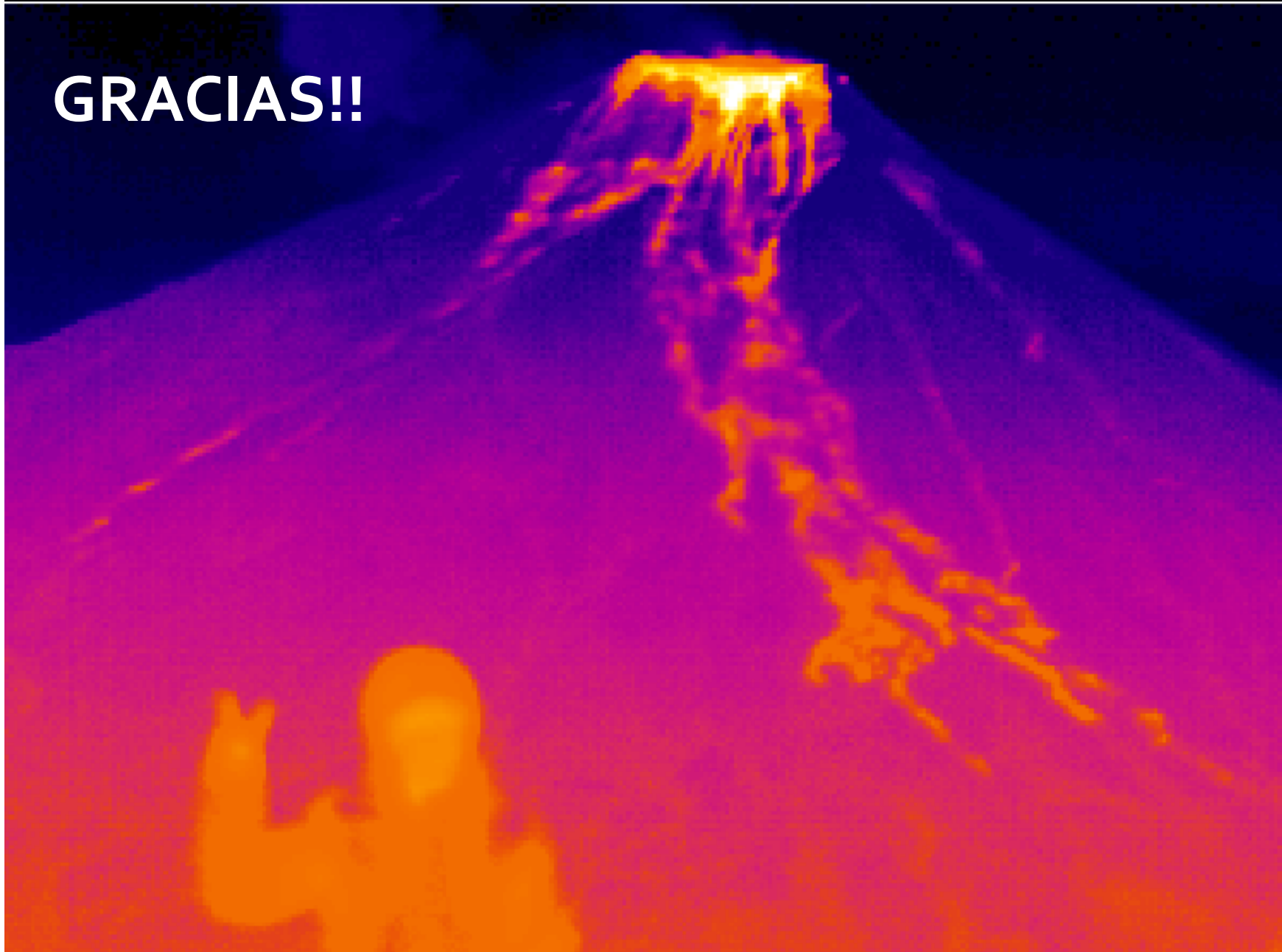
02:55:01



Pf's generated on may 28 , they were mapping using only thermal images



GRACIAS!!



69.9°C

1.2°C