Ring–shaped seismicity structures, being formed in the Alaska region: Justified prediction of the place and magnitude of the Simeonof earthquake of July 22, 2020 (Mw=7.8)

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Abstract We have been studying some seismicity characteristics connected with Simeonof earthquake of July 22, 2020 (Mw=7.8) in the area of Shumagin seismic gap, located in the region of South Alaska. 8 years before this event, the authors picked up here ring-shaped seismicity structure. Using characteristics of this structure we made a conclusion on preparation for large earthquake (Mw~8), similarly to many events in subduction zones. We used data on threshold magnitude and size of the ring structure, and earlier obtained dependences of these parameters on magnitudes of main events for the subduction zones in the Eastern Pacific. Accumulation of new seismicity data prior to 2020/07/22 allowed us to specify the source location and magnitude of the Simeonof earthquake: Mw=7.9±0.3. It was shown that after this event new ring structures continued to form, which can correspond to preparation for larger earthquake: Mw=8.2±0.2. Geodynamical processes, which lead to formation of the ring structures, are discussing.

Keywords Alaska, prediction of place and magnitude, Simeonof earthquake, ring-shaped seismicity structures.

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References

Karakin, A.V., & Lobkovsky, L.I. (1983). [Hydrodynamics and structure of the two-phase asthenosphere]. *Doklady AN SSSR* [Transactions (Doklady) of the USSR Academy of Sciences. Earth Science Sections], *268*(2), 324-329. (In Russ.).

Kopnichev, Yu.F., Gordienko, D.D., & Sokolova, I.N. (2009). Space-time variations of the shear wave attenuation field in the upper mantle of seismic and low seismicity areas. *Journal of Volcanology and Seismology*, *3*(1), 44-58. doi: 10.1134/S0742046309010059

Kopnichev, Yu.F., & Sokolova, I.N. (2003). Spatio-temporal variations of the S wave attenuation field in the source zones of large earthquakes in the Tien Shan. *Izvestiya. Physics of the Solid Earth*, *39*(7), 568-579.

Kopnichev, Yu.F., & Sokolova, I.N. (2005). [Mantle fluids ascent in the regions of strong earthquake sources and large deep fault zones: geochemical evidences]. *Vestnik NIaTs RK* [NNC RK Bulletin], *2*, 147-155. (In Russ.).

Kopnichev, Yu.F., & Sokolova, I.N. (2009a). Ring seismicity in different depth ranges before large and great earthquakes in subduction zones. *Doklady Earth Sciences*, *425*(2), 448-450. doi: 10.1134/S1028334X09030222

Kopnichev, Yu.F., & Sokolova, I.N. (2009b). Characteristics of ring seismicity in different depth ranges before large and great earthquakes in the Sumatra region. *Doklady Earth Sciences*, *429*(1), 1385-1388.

Kopnichev, Yu.F., & Sokolova, I.N. (2010). On the correlation between seismicity characteristics and S-wave attenuation in the ring structures that appear before large

earthquakes. *Journal of Volcanology and Seismology*, *4*(6), 396-411. doi: 10.1134/S0742046310060047

Kopnichev, Yu.F., & Sokolova, I.N. (2011a). Annular seismicity structures and the March 11, 2011, earthquake (Mw=9.0) in Northeast Japan. *Doklady Earth Sciences*, *440*(1), 1324. doi: 10.1134/S1028334X11090194

Kopnichev, Yu.F., & Sokolova, I.N. (2011b). [Heterogeneity of the short-period S wave attenuation in the source zone of the Maule earthquake in Chile (27.02.2010, Mw=8.8) and its relation to seismicity and volcanism of the region]. *Geofizicheskie issledovaniia* [Geophysical Research], *12*(3), 22-32. (In Russ.).

Kopnichev, Yu.F., & Sokolova, I.N. (2012). [Ring-shaped seismicity structures in different depth ranges priorto large and great earthquakes in the regions of Aleutians and Alaska]. *Vestnik NIaTs RK* [NNC RK Bulletin], *1*, 137-146. (In Russ.).

Kopnichev, Yu.F., & Sokolova, I.N. (2013). [Ring-shaped seismicity structures, being formed prior to large earthquakes with different mechanisms within intracontinental regions]. *Geofizicheskie issledovaniia* [Geophysical Research], *14*(1), 5-15. (In Russ.).

Kopnichev, Yu.F., & Sokolova, I.N. (2015). [Ring-shaped seismicity structures in the region of Northern Chile and successful prediction of place and magnitude of the Iquique earthquake of 01.04.2014 (Mw=8.2)]. *Vestnik NIaTs RK* [NNC RK Bulletin], *4*, 153-159. (In Russ.).

Kopnichev, Yu.F., & Sokolova, I.N. (2018). Ring-shaped seismicity structures in the cascadia subduction zone: possible upcoming large earthquakes. *Izvestiya. Atmospheric and Oceanic Physics*, *54*(7), 745-752. doi: 10.1134/S0001433818070046

Kopnichev, Yu.F., & Sokolova, I.N. (2019). Characteristics of the short-period S-wave attenuation field in the source zone of the strongest Tohoku earthquake of March 11, 2011 (Mw=9.0). *Izvestiya. Atmospheric and Oceanic Physics*, *55*(8), 804-815. doi: 10.1134/S0001433819080061

Kopnichev, Yu.F., & Sokolova, I.N. (2020). [Ring-shaped seismicity structures in different depth ranges prior to large and great earthquakes in subduction zones of the Pacific Ocean]. *Vestnik NIaTs RK* [NNC RK Bulletin], *3*, 135-141. (In Russ.).

Letnikov, F.A. (1992). *Sinergetika geologicheskikh sistem* [Synergetics of geological systems]. Novosibirsk, Russia: Nauka Publ., 229 p. (In Russ.).

Van'jan, L.L., & Hajndman, R.D. (1996). [On the nature of the electrical conductivity of the consolidated crust]. *Fizika Zemli* [Physics of the Solid Earth], *4*, 5-11. (In Russ.).

Davies, J., Sykes, L., House, L., & Jacob, K. (1981). Shumagin seismic gap, Alaska Peninsula: history of great earthquakes, tectonic setting, and evidence for high seismic potential. *Journal of Geophysical Research*, *86*(B5), 3821-3855.

Fournier, T., & Freymueller, J. (2007). Transition from locked to creeping subduction in the Shumagin region, Alaska. *Geophysical Research Letters*, *34*, L06303. doi: 10.1029/2006GL029073

Gold, T., & Soter, S. (1984/1985). Fluid ascent through the solid lithosphere and its relation to earthquakes. *Pure and Applied Geophysics*, *122*, 492-530.

Husen, S., & Kissling, E. (2001). Postseismic fluid flow after the large subduction earthquake of Antofagasta, Chile. *Geology*, *29*(9), 847-850.

Liu, C., Lay, T., Xiong, X., & Wen, Ya. (2020). Rupture of the 2020 Mw 7.8 earthquake in the Shumagin gap inferred from seismic and geodetic observations. *Geophysical Research Letters*, *47*(22). doi: 10.1029/2020GL090806

Nadin, E. (2020). Does Alaska's magnitude-7.8 Simeonof earthquake finally close a seismic gap? *Temblor*. doi:10.32858/temblor.106

Ogawa, R., & Heki, K. (2007). Slow postseismic recovery of geoid depression formed by the 2004 Sumatra-Andaman earthquake by mantle water diffusion. *Geophysical Research Letter*s, *34*, L06313. doi: 10.1029/2007GL029340

Singh, S., & Suarez, G. (1988). Regional variation in the number of aftershocks ($m_b \geq 5$) of large subduction-zone earthquakes (Mw≥7.0). *Bulletin of the Seismological Society of America*, *78*(1), 230-242.

Yamazaki, T., & Seno, T. (2003). Double seismic zone and dehydration embrittlement of the subducting slab. *Journal of Geophysical Research*, *108*(B4). doi: 10/1029/2002JB001918

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