

## Library Award Application Essay

As a geology and physics major, I have a strong interest in the oil and mining industries and how to improve methods for natural resource recovery, both in terms of efficiency and minimizing impact on surrounding ecosystems. One issue encountered in the oil and gas industry is the problem of induced seismicity through either drilling associated with mining operations or fluid migration due to hydraulic fracturing. Such seismicity can negatively impact surrounding ecosystems as well as manmade infrastructure, as occurred during the 2011 Virginia earthquake or the earthquakes in Oklahoma that are happening with increasing frequency. My research topic proposes to characterize the morphology of such sequences of microseismic events, which in turn can be used to understand how microseismicity due to drilling and hydraulic fracturing occurs, as well as other applications, which finally can be used to understand how to stop such effects in the natural resource industry.

I discovered my sources through a variety of methods. My advisor on the research project, Prof. Lekic, first gave me a few papers to read in order to understand the methods I'd be working with as well as background on the subject of seismic swarms and how current research regards their mechanisms. In order to expand my knowledge base, I used Research Port in order to find more databases that would contain scientific papers relevant to seismic swarms or how to process catalogs of earthquake events, the latter of which I would be doing in my research project in order to find and characterize swarms. Finally, I looked at citations in the papers I read in order to understand the methods and background they based their research on.

Throughout my research project, my advisor in the project has been instrumental to both my progress and overall growth as a scientific researcher. Prof. Lekic has mentored me thoroughly in the background of seismology, which I had no experience in prior to entering his lab, as well as teaching me coding languages I've needed in order to advance my research. At first, we were only working with one method that had been established by two previous investigators, Vidale and Shearer (2006), and were working with a program that had been written by one of his former students, Jeff Gay. However, once we realized that program might not be as effective at identifying swarm events as we had initially thought, he not only encouraged me to take a look at other research to see what their methods were, but also helped me to write another program based off another method developed by Zaliapin et al. (2008), which so far I have proven to be more effective at identifying swarm events than that of Vidale and Shearer's method. Therefore, Prof. Lekic facilitated my using my research project to demonstrate that not all methods of swarm identification are created equal, a different direction than I had initially thought of.

I used a variety of criteria for selecting my sources. First, there were sources that I used for the basis of my methods, such as Zaliapin et al. (2008)'s method of swarm identification, the math for which was based on Baiesi and Paczuski (2004)'s scale-free networks calculations. In addition, I also selected resources that demonstrated novel concepts regarding swarms or offered differing conclusions from the papers I was basing my methods off of. For instance, Vidale and Shearer (2006) concluded that seismic swarms exhibited an exponential decay curve for the number of events over time. However, Fischer and Josef Horálek (2003) offer the alternative conclusion that the swarms they investigated exhibited a Gaussian distribution for the number of events over time. Finally, I selected sources that gave applications as to why studying seismic swarms contributed to the greater body of geologic research, such as Shapiro and Dinske (2008), in which they investigated induced seismicity in hydraulic fracturing and demonstrated that natural seismic swarms, which is what I'm investigating, could be used as a model for such anthropogenic seismicity.

During my research experience, I've grown both as a student and as a scientific investigator. I've learned how to read research papers more effectively as well as find relevant research for my topic through a variety of sources. I've learned about the basics of seismology, how to code, as well as how to collaborate with colleagues towards a common goal. I've also learned how to use library resources more effectively. Research Port, which I had used possibly once before, was an organized database that I could easily find papers to advance my overall research goals. This in turn made my research more structured and effective, which finally allowed me to accomplish more last semester than I had originally thought possible. Through my research, I hope to be able to make more academic connections, which will help me to pursue my objective of graduate school after graduation, and finally a job in the oil industry.

The only thing I would change in my research experience is not getting started sooner. I've really enjoyed all I've accomplished so far, and I'm excited to see where my investigation of seismic swarms takes me next. With regards to how the library could be a better resource for my research needs, having librarians on hand that are experts in a given research subject would be a fantastic way for the library and university to utilize both its prolific teaching staff as well as break down the vast amount of literary resources the library has on hand. Being able to speak with someone who had experience finding scientific papers in geology would have cut down my time looking for papers drastically, as well as having more information to base my understanding off of might have sent me in more research directions. Overall, the library system is a fantastic resource for any student, and this research project has made me realize just how much more I should regularly utilize it.