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Assessment of geologic programs in higher educational institutions of Chile

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ABSTRACT

In Chile, the subject of geology has historically been significant mostly due to the presence of world-class mineral deposits and highly profitable mines. Considering variable trends in mining, academic institutions with geology programs in Chile were analyzed to provide an evaluation of their current state and projected development across the country. Through the compilation of 5 years of data, a comparison was undertaken in relation to the age of the programs, their respective lifespans, geographic distributions, vacancies, annual entry fees, yearly tuitions, scores on admission tests, curricula, and human resources and infrastructure. The main results indicate the following: most of the new programs are located in or near the Metropolitan Region due to population trends rather than the locations of mines, the actual number of new students may double the total amount of vacancies, the student program fee tends to increase with time and varies between the programs with no apparent relationship to quality, there exists a strong variation in scores needed to enter into the geology programs, and currently there are more individuals studying geology than total graduates. When considering the unfavorable projections for mining in Chile, it is conclusive that this career will not yield the anticipated benefits for graduates unless new, more diverse professional opportunities develop in other sectors.

1. Introduction

The field of geology is important in Chile. The country is located along an active tectonic margin subject to numerous geologic hazards. Despite this, geology as a science has been developed in Chile largely due to the predominance of commodity-based mining and the presence of world-class, recoverable deposits within the country. For example, La Escondida Mine in northern Chile, the largest copper mine in the world, produced 1,152,510 tons of refined copper and employed 3798 workers in 2015 (Mining Advice, 2015). Northern Chile in particular is characterized by a multitude of ore deposits that are found in longitudinal belts extending southward until 23°S (Maksaev, 2001; Sillitoe, 1997). As a result, mines are a common workplace for geologists in Chile.

Academic programs in universities of Chile, in a similar manner to other countries, serve to prepare individuals for professional work. Therefore, an assessment of the current and projected state of geologic programs, including the quality of education, is considerably important. To date, such an evaluation has not been undertaken in Chile.

The beginning of related academic degrees in Chile can be traced to the first geology program which had its initial graduates in 1957 at the Universidad de Chile through what was called a Special Class for Geologists (Hervé, 2012). In 1968, this program became available at the Universidad Católica del Norte, in 1982 at the Universidad de Concepción, and in 2007 at the Universidad de Atacama (Table 1 and Fig. 1). By that time, a new geology program had developed every 12.5 years (Aguirre, 2014; Tapia and Pereira, 2013).

Between 2008 and 2013, this study program was also available in other institutions and some of their satellite campuses. These universities included: Universidad Pedro de Valdivia in the Metropolitan[1] and Coquimbo regions; Universidad Nacional Andrés Bello in the Metropolitan, Valparaíso, and Biobio regions; Universidad Santo Tomás in the Metropolitan and Valparaíso regions; Universidad Austral de Chile, Universidad Católica de Temuco, and Universidad Mayor (Table 1 and Fig. 1). After 2007, the developing rate of geology programs in Chile increased dramatically to nearly 1 new program every year (Aguirre, 2014; Tapia and Pereira, 2013).

A general decrease in the demand for professional geologists is observed in Chile currently. This trend is a result of the decrease in copper prices and overall diminished growth of mining projected until 2020–2024 (Innovum and Chile Foundation, 2013, 2015). In spite of

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[1] This program was available until 2016 and is not offered currently.

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Table 1
Educational institutions that offer a geology program in Chile, with the location, starting year, length of the program, and state of accreditation. Notes: 1 academic year in Chile corresponds to 2 semesters; Universidad Católica del Norte had a program length of 12 semesters when this study was conducted, however currently the length is 10 semesters.

Institution	Region of campus or satellite campus	Region number	Year of formation	Length of the program	Accredited?
U. de Chile	Metropolitan Region	XIII	1952	12 semesters	yes, for 7 years, until 2022
U. Católica del Norte	Antofagasta Region	II	1968	12 semesters	yes, for 5 years, until 2017
U. de Concepción	Biobio Region	VIII	1982	12 semesters	no
U. de Atacama	Atacama Region	III	2007	12 semesters	no
U. Pedro de Valdivia (XIII)	Metropolitan Region	XIII	2009	10 semesters	no
U. Pedro de Valdivia (IV)	Coquimbo Region	IV	2009	10 semesters	no
U. Nacional Andrés Bello (XIII)	Metropolitan Region	XIII	2011	10 semesters	no
U. Nacional Andrés Bello (V)	Valparaíso Region	V	2011	10 semesters	no
U. Nacional Andrés Bello (VIII)	Biobio Region	VIII	2011	10 semesters	no
U. Santo Tomás (XIII)	Metropolitan Region	XIII	2012	10 semesters	not eligible
U. Santo Tomás (V)	Valparaíso Region	V	2012	10 semesters	not eligible
U. Austral de Chile	Los Ríos Region	XIV	2013	10 semesters	not eligible
U. Católica de Temuco	Araucanía Region	IX	2013	10 semesters	not eligible
U. Mayor	Metropolitan Region	XIII	2013	10 semesters	not eligible
U. del Desarrollo	Metropolitan Region	XIII	2014	10 semesters	not eligible
U. Central de Chile	Metropolitan Region	XIII	2015	10 semesters	not eligible

that, new geology study programs are still being developed in higher educational institutions. For example, in 2014 a program was opened at the Universidad del Desarrollo as well as at the Universidad Central de Chile in 2015 (Tapia and Durán, 2015). Due to this increased development, a comparison of the programs offered is necessary to analyze the current and prospective state of geology as a career in Chile. Furthermore, the unique market of higher education in Chile (Matear, 2007; Monckeberg, 2007) may decouple this development from the actual demand of professional geologists in the country.

During the last 5 years, data from higher educational institutions that offer geology programs in Chile has been compiled. Differences in the annual entry fee, yearly tuition, number of new student vacancies, required entry scores, curricula, quantity of students and professors, and the accreditation status of the programs were compared and analyzed to understand the dramatic changes that this discipline has undergone and is currently experiencing in Chile. The following research questions in particular will be explored:

1. How do changes in the enrollment growth affect the location, fees, vacancies, and scores in old and new geology programs?
2. Are the curricula offered by the different institutions adequate in a country regularly affected by geologic hazards?
3. Is there a relationship between the quality of education and geologic program fees offered in higher educational institutions of Chile?
4. Why has the demand for geology programs changed so dramatically in the last 10 years?
5. What are the consequences of the increase of geology programs in Chile?

2. Work methodology

To quantify the changes in geology student enrollment as well as the current state of geology as a profession in Chile, information was gathered related to (i) the geology programs offered at universities in Chile, and (ii) the public and private institutions hiring geologists in Chile. The compiled data was analyzed to compare the quality of the programs (Section 3.4.2), which in this study refers to their professional and academic readiness, individualized student attention, accreditation status, and success in terms of graduating numbers. The gathered information was also used to assess the possible causes of the observed increase in the number of geology programs and any impact or relation to the current state of the profession of geology in Chile.

2.1. Data from academic institutions

Starting 2012, all basic information shown by the institutional websites that offer a geology degree has been compiled yearly as an efficient and dependable way to obtain basic and comparable information related to the academic programs. This compiled data from the institutional websites includes the annual entry fee, yearly tuition, and entry scores, all of which are important characteristics to consider in the comparison of academic programs. The accreditation status of the programs was determined through the National Commission of Accreditation (CNA) online website (CNA, 2016).

In addition to the program information provided on websites, in September 2015, a questionnaire developed by the lead author was sent to all the 16 directors of geology programs in Chile (Fig. 1), signifying that the survey sample size and population were equal, in order to obtain more specific information regarding each program. This questionnaire categorized the various types of professors, their specializations and respective laboratories, and the number of graduands and graduates. It was also used to determine the year of formation of the programs, the number of research facilities, and data regarding human resources. The following institutions did not collaborate in the questionnaire: Universidad Pedro de Valdivia (Metropolitan and Coquimbo regions), Universidad Andrés Bello (Metropolitan and Valparaíso regions), Universidad Santo Tomás (Valparaíso Region), and Universidad del Desarrollo. Therefore data regarding their students, professors, and labs were not incorporated in this study.

Finally, average dropout rate statistics before or during 2016 were obtained for 6 programs in total (Section 3.4.3). Of the 6 programs, 5 directors and department deans provided formal reports. Related information from the other program, the Universidad Nacional Andrés Bello in the Biobio Region, was obtained informally (Bravo, personal communication).

2.2. Data from state and consulting agencies

To assess geology as a profession in Chile, information was also gathered from governmental and private institutions that hire geologists. Starting 2016, data was compiled in collaboration with the School of Geologists of Chile (*Colegio de Geólogos de Chile,* CGCh) through an online spreadsheet related to geologists in consulting and the respective consulting enterprises. Apart from the collection of data from academic intuitions described in Section 2.1, this spreadsheet was sent to 63 separate companies employing geologists to gather specific information regarding the number of employed geologists, fields of specialization, and office locations. In governmental institutions specifically, the number of employed geologists and their salaries were determined through revision of salary spreadsheets of the public institutions that generally hire geologists, such as the National Office of Emergencies (**ONEMI**), National Service of Geology and Mining (**SERNAGEOMIN**,