INTRODUCTION
There has been significant expansion within the Australian minerals industry over the past decade driven by a strong global demand for energy and minerals (IMF, 2010). Increased demand has led to a shortage of skilled professionals in the fields of engineering and geology (ABS, 2010). This shortage of mining professionals may have led to greater demands on new geologists who enter the sector. Anecdotal evidence suggests that the standard of training has fallen while the responsibilities of new professionals has increased and that access to training and additional support have been negatively impacted. This paper aims to quantify these changes.

Four main areas of interest are addressed:

• to quantify any changes that have occurred to the standards of training over the past 50 years,
• to compare and contrast styles of training utilised,
• compare the quality of training implemented by companies of differing size and type, and
• investigate and identify areas that may need improvement and discuss opportunities for training development.

METHODS
This study focuses on the initial training period of geologists within the Australian metalliferous and coal mining industries. Initial training typically includes a combination of graduate programs and junior positions within companies, focusing on the first two years of employment. In order to investigate the standard of training over a 50 year time period, a sample group of 435 geologists were surveyed.

The survey was designed by the authors in consultation with Dr Alan Gore, a statistical consultant with Three Colour Consulting. Questions were designed to meet the aims of the study in an unbiased manner, using a combination of multiple choice (yes/no and Likert scale), numeric open end and short answer questions. The questionnaire was reviewed by a conglomerate of geologists of varying experience levels as a pilot survey before distribution.

The online tool Survey Monkey was used to distribute the survey. Subject areas covered by the survey included:

• the year the geologist commenced training with an employer,
• level of tertiary education,
• location of initial training,
• the quality of the training,
• who they were trained by,
• their responsibilities to train others, and
• demographics of the respondent.

The survey was accessible over a period of three months and was distributed to geologists through a number of professional organisations, including The Australasian Institute of Mining and Metallurgy (The AusIMM), the Australian Institute of Geoscientists (AIG) and the Bowen Basin Geology Group, as well as direct invitation to public and private companies and a social networking site.

JMP statistical software has been used to analyse the data set. Statistical tests used to analyse the data set included the ANOVA, Tukey HTD and student t-tests.

In addition to the survey questionnaire a number of external references were acquired to contextualise the results. These data included:

• course completions for geology and earth science students within Australia (DEEWR, 2011);

ABSTRACT
Increasing growth in the minerals industry over the past decade has raised the question of whether the standard of training for new geologists has been negatively impacted. This hypothesis was tested by means of a survey. Factors considered included the quality of training and whether it has changed over the past 50 years, preferred styles of training compared to styles of training received and whether the quality of training provided by a company changed with the type or size of company.

Data from 435 survey respondents showed a consistent standard of training, but a significant increase in the level of responsibility allocated to new geologists. Those with increased responsibility also had reduced access to additional support and were often asked to perform tasks for which they had little or no training. New geologists were more likely to receive better quality training in a large company (over 100 employees) that owned the mine or exploration lease. A more structured training program was more likely to provide a higher quality result than those with minimal or no structure.

Training our New Starters – Between a Rock and a Hard Place
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• commodity price indices for energy, industrial materials and metals (IMF, 2011); and
• expenditure on exploration and metres drilled within Australia (ABS, 2011).

The Australian Graduates surveys from 1989 to 2009 were accessed from Graduate Careers Australia, from which the percentage of graduates employed was used.

RESULTS

A total of 435 geologists completed the survey. The sample population had a broad range of experience working as geologists, which was measured by the year they commenced training with an employer. The largest group had commenced work since 2000 (39 per cent), followed by slightly decreasing numbers for the preceding decades: 1990 - 2000 (19 per cent), 1980 - 1990 (16 per cent), 1970 - 1980 (14 per cent) and prior to 1970 (12 per cent). The age distribution of respondents generally reflected their years of experience. The most experienced geologist in the sample group commenced work in 1956.

The majority of respondents commenced their training in New South Wales (29 per cent), Queensland (28 per cent) or Western Australia (24 per cent), with minor input from the remaining states and territories. Just under two-thirds of the sample population commenced work in the minerals and metals sector (60 per cent) followed by coal and coal seam gas sector (37 per cent), with the oil and gas sector making up the remainder of those surveyed (three per cent).

From the results returned from the 435 respondents, the four main areas of interest described above were addressed.

Changes in the standard of training over the past 50 years

The standard of training was gauged using four quality indicators:
1. the quality of information provided,
2. the timeliness of the information provided,
3. the methods of communication, and
4. the level of responsibility in relation to the level of training.

All indicators were measured using a Likert scale. These quality indicators were compared to the year the geologist commenced training with their employers.

The quality of information provided to new geologists was generally satisfactory to excellent. The decades 1980 - 1990 and 2000 to present showed an increase in the proportion of respondents who received less than satisfactory or poor quality of information. The timeliness of information was generally aligned with work tasks. There was an increase in the proportion of respondents who indicated that the information provided lagged behind their work tasks from 2000 to present. The methods of communication for the most part were satisfactory or good. There was no apparent change in the standard of methods of communication over the past five decades.

The level of responsibility in relation to the level of training showed that a large number of geologists in the most recent decade felt that they were allocated too much responsibility. Prior to this decade most new geologist felt that their level of responsibility was suitable for their level of training, with only a small number of respondents indicating that they were given insufficient responsibility.

Compare and contrast styles of training

Respondents were asked to choose from a list of differing styles of training, identifying styles of training they received, as well as those they would have preferred. These styles can be grouped as: location of training, the people who trained the geologist and theoretical training compared to practical. Selections were not mutually exclusive within each category – rather respondents could select as many options as necessary.

The location of training included field based training, office based training, or external training. Respondents indicated that they most commonly received field based training, followed by office based training, but rarely received external training. The preferred location of training was field based, although office-based training still ranked highly (Figure 1).
The styles of training in relation to people involved in the training included:
- one-on-one training,
- formal mentoring arrangement,
- informal mentoring arrangement,
- peer group,
- observation,
- team-based training, and
- being ‘thrown in the deep end’.

The most common styles of training received in this category were ‘thrown in the deep end’, followed by an informal mentoring arrangement and observation, with one-on-one training ranking fourth. Nearly half of the surveyed group indicated that they were ‘thrown in the deep end’. There was a uniform distribution across all years of experience for those who were ‘thrown in the deep end’. Styles of training that were preferred included one-on-one training, followed by observation, team based training and a mentoring arrangement, either formal or informal (Figure 1).

Comparisons of theoretical training to practical training asked respondents to choose from theory only, theory prior to practical, theory combined with practical, theory after practical or practical only. Theory combined with practical was the preferred option in this category by a substantial margin. Only a small number of respondents received theory only and no geologists selected this as a preferred style of training. Practical Training only was received by a large number of respondents, but this scored poorly as a preferred option (Figure 1).

**Contrasts in the quality of training implemented by companies of differing sizes and types**

The quality of training provided by a company was described using the following indicators:
- the structure of the training program,
- the systems and documentation the company had in place,
- access to additional support, and
- the alignment of work tasks with training.

These areas were compared with the size and type of the company – whether it was the owner of the mine or exploration lease, a contractor or consultancy, government or academic.

The majority of the respondents undertook their initial training with the owner of a mine and/or exploration lease (67 per cent), with 27 per cent commencing training with consultants or contractors and the remainder beginning with government agencies or as academics. Those trained in academic institutions constituted such a small population that they are not included in these comparisons. Most employees worked for companies with greater than 100 employees (47 per cent), with other categories including 51 - 100 employees (12 per cent of the sample population), 31 - 50 employees (nine per cent), 11 - 30 employees (16 per cent), 6 - 10 employees (eight per cent) and 1 - 5 employees (seven per cent).

The majority of respondents indicated that their training programs incorporated minimal or no structure. The structure of training programs did increase in companies with greater than 100 employees. Geologists who began work with a consultancy or contractor more commonly had no structure in their training programs than those working for the mine or exploration lease owner.

Comparisons of the level of structure of a training program and the quality indicators described previously showed that the standard of training is improved with increased structure. The quality of systems and documentation in place for training of new geologists improved as the size of the company increased. In this area mine or exploration lease owners performed slightly better than consultancies or contractors.

All companies performed poorly in regards to providing access to additional support for new geologists, with the majority of respondents indicating they had access to limited or no additional support. There was no substantial difference between company types or size for this variable. Generally alignment of training with work tasks was satisfactory to excellent. Employers with 11 - 50 employees more commonly had less than satisfactory or poor alignment of training with work tasks. Geologists who were employed by the mine or exploration lease owner were more commonly satisfied with the alignment of training and work tasks.

**DISCUSSION**

The quality of training of new geologists has not been identified as changing over the past 50 years, however, the data has highlighted that the level of responsibility delegated to new geologists has increased dramatically in the last ten years. Those allocated a greater level of responsibility in relation to their training also had less access to additional support compared to those given a suitable level of responsibility. Geologists who indicated that they were allocated too much responsibility often performed tasks for which they had no training.

The hypothesis of this study proposed that the expansion of the minerals and energy industries over the past decade would have negatively impacted the quality of training and imposed greater demands upon new geologists. The key findings from this survey are no change in the standard of training, an increase in the level of responsibility in relation to the level of training, coupled with a lack of access to additional support.

Further to this we find that new geologists entering the industry (within the last ten years) were increasingly expected to perform tasks for which they had received no training.

A common perception amongst geologists is that bigger companies had better training programs, in particular more structured programs. The results showed that in most of the quality indicators for training provided by a company, mine or exploration lease owners performed better than consultancies or contractors. Similarly, companies with over 100 employees generally performed better than smaller companies. Whether a more structured training program provided better quality training was also tested. The comparison of structure compared to the four key quality indicators showed that the quality of training improved with structure. The level of structure of training programs increased with company size. The findings support the original perception that a larger company with a better structured training program will provide a better foundation for new geologists.

Initial discussions of this study returned comments that it would be useful to understand what styles of training are of most benefit to young geologists. The survey only recorded qualitative data on perceptions of the training geologists would prefer, which may not be synonymous with beneficial training. Preferred styles of training included a combination of office and field based training; both theory combined with practical training; one-on-one and team based training, observation and a mentor (either formal or informal).

The preference of practical training combined with theoretical training for new geologists contrasts with the results of our questions about university education, which was generally found to be much more theoretical than practical.
It raises an often debated question as to whether universities should provide vocational training or not, but this goes beyond the scope of this paper.

A common perception amongst new geologists is that they are doing it tougher than previous generations, more commonly being ‘thrown in the deep end’ than their predecessors. The results showed the number of respondents who had been ‘thrown in the deep end’ has not changed over the past 50 years. The comments from this part of the survey expanded upon this point to show more experienced geologists looked back upon this type of training as a positive experience, where as those in the midst of their early training or with only a few years of experience often commented that it was a very negative experience. This raises the question of whether this type of training is easier to appreciate in retrospect, or whether there has been a decrease in fortitude in the more recent generation of geologists.

The survey revealed that the majority of geologists do not believe there has been a change in the standard of training of new geologists over the past 50 years. Conversely, a large number of geologists believed that there had been a decrease in the standard of the new geologists themselves. All age groups indicated that they believed there was a decline in standards, including those with less than five years of experience.

As the expenditure on exploration and commodity prices have increased (ABS, 2010; IMF, 2010), the number of Australian geologists graduating has decreased (DEEWR, 2011), as shown in Figure 2. A common story from employers tells of ‘ten positions advertised but only five applications received’. With increased demand and decreased supply, the employer’s choice becomes limited and new geologists of a lower standard may be more likely to be employed than previously.

**CONCLUSIONS**

Whereas the quality of training has remained consistent over the past 50 years, the responsibility delegated to new geologists has increased substantially and the current training does not support this. New geologists require greater access to additional support and removal of the requirement to regularly perform tasks for which they have received no training. The training should ideally include a combination of office and field based training, in an individual and group environment with access to a mentor. A well-structured training program will return a higher quality result than one with minimal or no structure. A new geologist is more likely to receive better quality training in a large company, who owns the mine or exploration lease, compared to a consultancy or contractor.

Our study has found no evidence that the minerals boom has had a negative impact on the standards of training but that there are a number of opportunities for improvement in training methods that will be beneficial to new geologists and the industry as a whole.

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**REFERENCES**

