# Course Syllabus: Magmatic Systems - ErSE 290D

<table>
<thead>
<tr>
<th>Division</th>
<th>Physical Science and Engineering Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Number</td>
<td>ErSE 290D</td>
</tr>
<tr>
<td>Course Title</td>
<td>Magmatic Systems</td>
</tr>
<tr>
<td>Academic Semester</td>
<td>Spring</td>
</tr>
<tr>
<td>Academic Year</td>
<td>2019/2020</td>
</tr>
<tr>
<td>Semester Start Date</td>
<td>01/26/2020</td>
</tr>
<tr>
<td>Semester End Date</td>
<td>05/13/2020</td>
</tr>
<tr>
<td>Class Schedule (Days &amp; Time)</td>
<td>02:30 PM - 04:00 PM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructor(s)</th>
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</thead>
<tbody>
<tr>
<td>Name</td>
<td>Froukje Marieke van der Zwan</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:FROUKJE.VANDERZWAN@KAUST.EDU.SA">FROUKJE.VANDERZWAN@KAUST.EDU.SA</a></td>
</tr>
<tr>
<td>Phone</td>
<td>+966128087856</td>
</tr>
<tr>
<td>Office Location</td>
<td>0237 (SEASIDE), 5, Al-Kindi (bldg. 5)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Teaching Assistant(s)</th>
<th></th>
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<tbody>
<tr>
<td>Name</td>
<td></td>
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<td>Email</td>
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## Course Information

### Comprehensive Course Description

This course introduces Magmatic Systems, discussing magmatic processes in the Earth and the rocks formed by them from different perspectives:

(A) Magmatism in the geological framework:
- Understanding how melts are formed, where and how this relates to the chemical composition of igneous rock samples.
- Explaining the links between solid earth processes and magmatism, i.e. why and where in a plate tectonic framework melts are formed and volcanism occurs. We will cover all major geodynamic settings in which magmatism occurs (mid-ocean ridges, hotspots, subduction volcanism, continental volcanism).
- Volcanism: looking at the different volcano types that form by different magmatic processes, their eruptive products and the hazards they produce.

(B) Different petrological and geochemical techniques:
- Petrography of igneous rocks, both in hand specimen and in thin section, understanding how different rocks minerals and textures are formed and which processes they reflect. Including the interpretation of phase diagrams and rock classification plots.
- Principles of major element, trace element and isotope geochemistry of igneous rocks.
- Basics of working with fluid and melt inclusions

The course will consist of a series of lectures and practical work in the form of rock descriptions, microscope work and geochemical exercises.

### Course Description from Program Guide

The course discusses magmatic processes in the Earth and the rocks formed by them from different perspectives. Magmatism in the geological framework: Understanding how melts are formed and how they are related to solid earth plate tectonic processes. We will cover all major geodynamic settings in which magmatism occurs and see how different processes result in different geochemical rock compositions. Additionally, we will evaluate different volcano types that form by different magmatic processes, their eruptive products and their associated volcanic hazards. Different petrological and geochemical techniques: Petrography of igneous rocks (hand specimen, thin sections), igneous geochemistry (major elements, trace elements, volatile), fluid and melt inclusion analytics. The course will consist of a series of lectures and practical work in the form of rock descriptions, microscope work and geochemical excersizes.
<table>
<thead>
<tr>
<th>Goals and Objectives</th>
<th>After completing this course, students will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Know how melts are formed</td>
<td>- Understand in which geodynamic settings magmatism occurs</td>
</tr>
<tr>
<td>- Understand in which geodynamic settings magmatism occurs</td>
<td>- Know the characteristics of rocks from different tectonic settings</td>
</tr>
<tr>
<td>- Evaluate different magma chamber processes acting on rock samples</td>
<td>- Know various geochemical techniques</td>
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<tr>
<td>- Know the characteristics of rocks from different tectonic settings</td>
<td>- Recognise and describe magmatic rocks in hand specimen</td>
</tr>
<tr>
<td>- Study magmatic minerals and rocks in thin section</td>
<td>- Read phase diagrams and rock classification diagrams</td>
</tr>
<tr>
<td>- Use major and trace element plots to understand the magmatic history of a rock</td>
<td>- Understand the use of melt and fluid inclusions</td>
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<table>
<thead>
<tr>
<th>Required Knowledge</th>
<th>A basic understanding of geological processes and tectonic settings. Basics of chemical elements. Excel basics.</th>
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<tbody>
<tr>
<td>Reference Texts</td>
<td>TBD</td>
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<table>
<thead>
<tr>
<th>Method of evaluation</th>
<th>30.00% - Final exam</th>
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<tbody>
<tr>
<td></td>
<td>10.00% - Quiz(zes)</td>
</tr>
<tr>
<td></td>
<td>30.00% - Midterm exam</td>
</tr>
<tr>
<td></td>
<td>30.00% - Homework /Assignments</td>
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| Nature of the assignments                                                          | - Handspecimen descriptions and microscope work                                                                             |
|                                                                                    | - Working with geochemistry data (in excel)                                                                                 |

| Course Policies                                                                    | Attendance: At least 80% attendance. Punctuality is required. It is the students responsibility to contact the instructor prior to absence, alert him to late assignments and discuss with the instructor how to make up. Wireless communication systems (cell phones) must be turned off during the lectures and lab work. |

| Additional Information                                                              |                                                                                                                           |
# Tentative Course Schedule

(Time, topic/emphasis & resources)

<table>
<thead>
<tr>
<th>Week</th>
<th>Lectures</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sun 01/26/2020</td>
<td>Introduction to magmatic systems</td>
</tr>
<tr>
<td>1</td>
<td>Thu 01/30/2020</td>
<td>Practical work: hand specimen descriptions</td>
</tr>
<tr>
<td>2</td>
<td>Sun 02/02/2020</td>
<td>Theory of rock classification and petrographic descriptions</td>
</tr>
<tr>
<td>2</td>
<td>Thu 02/06/2020</td>
<td>Practical work: hand specimen descriptions</td>
</tr>
<tr>
<td>3</td>
<td>Sun 02/09/2020</td>
<td>Theory of microscope petrography</td>
</tr>
<tr>
<td>3</td>
<td>Thu 02/13/2020</td>
<td>Practical work: microscopic descriptions</td>
</tr>
<tr>
<td>4</td>
<td>Sun 02/16/2020</td>
<td>Petrography – igneous textures</td>
</tr>
<tr>
<td>4</td>
<td>Thu 02/20/2020</td>
<td>Practical work: microscopic descriptions</td>
</tr>
<tr>
<td>5</td>
<td>Sun 02/23/2020</td>
<td>Melting processes</td>
</tr>
<tr>
<td>5</td>
<td>Thu 02/27/2020</td>
<td>Practical work: microscopic descriptions</td>
</tr>
<tr>
<td>6</td>
<td>Sun 03/01/2020</td>
<td>Melting and the effect on trace elements</td>
</tr>
<tr>
<td>6</td>
<td>Thu 03/05/2020</td>
<td>Practical work: microscopic descriptions</td>
</tr>
<tr>
<td>7</td>
<td>Sun 03/08/2020</td>
<td>Exercise: rare earth elements during melting</td>
</tr>
<tr>
<td>7</td>
<td>Thu 03/12/2020</td>
<td>Practical work: microscopic descriptions</td>
</tr>
<tr>
<td>8</td>
<td>Sun 03/15/2020</td>
<td>Mantle and mantle rocks</td>
</tr>
<tr>
<td>8</td>
<td>Thu 03/19/2020</td>
<td>Mid-term Exam</td>
</tr>
<tr>
<td>9</td>
<td>Sun 03/22/2020</td>
<td>Plate tectonics and volcanism – MOR</td>
</tr>
<tr>
<td>9</td>
<td>Thu 03/26/2020</td>
<td>Plate tectonics and volcanism – hydrothermalism at MOR</td>
</tr>
<tr>
<td>10</td>
<td>Sun 03/29/2020</td>
<td>Plate tectonics and volcanism – hotspots</td>
</tr>
<tr>
<td>10</td>
<td>Thu 04/02/2020</td>
<td>Plate tectonics and volcanism – subduction zones</td>
</tr>
<tr>
<td>11</td>
<td>Sun 04/05/2020</td>
<td>Plate tectonics and volcanism – continental volcanism</td>
</tr>
<tr>
<td>11</td>
<td>Thu 04/09/2020</td>
<td>Magma chamber processes I</td>
</tr>
<tr>
<td>12</td>
<td>Sun 04/12/2020</td>
<td>Magma chamber processes II</td>
</tr>
<tr>
<td>12</td>
<td>Thu 04/16/2020</td>
<td>Geochemistry exercise</td>
</tr>
<tr>
<td>13</td>
<td>Sun 04/19/2020</td>
<td>Volcanism – volcano eruption types</td>
</tr>
<tr>
<td>13</td>
<td>Thu 04/23/2020</td>
<td>Geochemistry exercise</td>
</tr>
<tr>
<td>14</td>
<td>Sun 04/26/2020</td>
<td>Volcanism – eruptive products</td>
</tr>
<tr>
<td>14</td>
<td>Thu 04/30/2020</td>
<td>Volcanism – volcanic hazards</td>
</tr>
<tr>
<td>15</td>
<td>Sun 05/03/2020</td>
<td>Melt inclusions</td>
</tr>
<tr>
<td>15</td>
<td>Thu 05/07/2020</td>
<td>Fluid inclusions</td>
</tr>
<tr>
<td>16</td>
<td>Sun 05/10/2020</td>
<td>Final Exam</td>
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**Note**

The instructor reserves the right to make changes to this syllabus as necessary.