Using geosciences and mythology to locate Prospero's Island

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Abstract. *The Tempest*, the last work entirely attributed to William Shakespeare, has been subject to many studies and interpretations, ranging from adventure, Shakespeare's biography to colonialism and cultural revolution and is studied in this paper in the context of natural occurring hazards. The play tells about a magician, Prospero, and his daughter who are shipwrecked on an unknown island where they encounter strange creatures and beings. But is it a fantastic island or was the author inspired by real places? Literary scholars proposed several hypotheses through the years based on historical sources. Here we analyse the play in the light of geosciences and mythology supporting the hypothesis that the playwright was inspired by the Mediterranean. Our goal is not to identify the island but rather to examine the various geographical and philosophical-political factors that may have influenced Shakespeare's literary creation. Nevertheless, some verses of the play suggest volcanism placing the island in the Sicilian sea. This underlines once again how deep the knowledge of the playwright about Italy was. It also suggests that this part of the Mediterranean was known, at the time of Shakespeare, as the theatre of phenomena originated in the volcanism of the area. One implication is that he could have used historical sources still unknown and precious to reconstruct geological events occurred out off the Sicilian coast.

1 Introduction

A new trend towards the re-unification of the two main streams of culture, the humanistic and the scientific, is becoming more evident year by year. Scientists and artists co-create projects to address issues of societal importance in a holistic way and to improve on science communication. Earth scientists, in particular, are familiar with studying historical records and literary accounts, mythology, story telling in addition to geo-archaeological evidences to reconstruct a time line of historic

catastrophic events such as earthquakes, volcano outbreaks, floods, storms, etc. Even with the evolution of technology that has brought geo-scientists new sophisticated methods of investigation, modern seismology cannot do without a deep immersion into historical and literary accounts for calculating, for instance, the return period of an earthquake. The Istituto Nazionale di Geofisica e Vulcanologia (INGV) contributed significantly to this by collecting in an original volume the ancient earthquakes in the Mediterranean area up to the 10th century (Guidoboni et al. 1995). Another important contribution is the catalogue of strong Italian earthquakes (Boschi, E. et al 1995). The catalogue is kept up to date and recently has been extended to the large earthquakes (6.0-6.9 Magnitude) of the Mediterranean area (Guidoboni, E. et al. 2019). Collecting literary accounts ranging from historical sources until the most recent chronicles allows to document also minor, little details, that might help to better understand an earthquake of the past in terms of Magnitude, intensity and social impact.

Combining history, literature, geo-mythology and archaeology accounts play a fundamental role in reconstructing past volcanic events and their impacts on society and environment. In the renown case of the 79 AD Vesuvius Eruption that destroyed Pompeii and Herculaneum, the accounts of Pliny the Younger, a Roman administrator and a poet, who witnessed and documented the catastrophic event in a letter to Tacitus (Jones 2001), helped geoscientists to reconstruct the several earthquakes that preceded the event. The effects are still visible in several buildings in Pompeii and Villa Regina. Observing the event from Misenum at a distance of 21 km, Pliny described the eruptive cloud as a "Mediterranean pine". During the morning of the second day, he observed the development of pyroclastic flows descending down the flanks of Vesuvius and flowing on the sea. The description fits well the geologic record of the eruption (Giacomelli et.al 2003).

Some events remain difficult to reconstruct because of a lack of observers. G. Mercalli (1883) asserts that there are only few records about volcanic eruptions at sea, since the phenomena at the time could be witnessed predominantly by sailors. Mercalli reports some episodes that happened in the Sicily Channel including the most popular Ferdinandea island emerging from the sea in 1831 (Fig.1). As we will show later, we are stunned by the way Shakespeare describes a natural phenomenon so similarly to the ones described by Mercalli in his book published two centuries later.

2 Methodology

In this paper we will do the opposite of what was previously described: we will use geosciences and geo-mythology to better understand a work of art wordily renown as a masterpiece of William Shakespeare (from now on WS): *The Tempest* (Kermode ed. 1986)

Although we consider the WS' authorship question an important aspect to address for better understanding his works, we will not discuss it here but we address the reader to a recent publication that considers it in a scientific perspective (Leigh, R. J. et al 2019). We are also aware that considering the play in the light of the early modern knowledge and the way it circulates is important, although do not guarantee a more precise interpretation of the verses. We cannot be sure of which texts WS used to build his own knowledge. At the same time, it is debated if WS knew classic languages sufficiently well to read the original sources, being deeply schooled in the classics (Werth 2002: Strtitmatter 2018).

Then, since there are many interpretation of *The Tempest* and at the same time, the biography of WS is also subject to many controversies, we take the approach that the text can be accepted as reliable source. The interpretation of the verses, although difficult, can enlighten us on the possibility that WS was truly inspired by real places and by natural phenomena. Here we propose that WS took inspiration mainly from that literature that directly takes origin in natural phenomena. In this perspective, the discipline of Geo-mythology is based on the idea that myths and legends have origin in the natural world and can be seen as a source of natural knowledge based on the observation of physical evidence. Early human civilizations used myths to organize and convey information for transmitting the wisdom necessary to live in harmony with and survive in nature (Lanza & Negrete 2007). The term was originally conceived as the geological application of the term 'euhemerism', from the Sicilian philosopher, Euhemerus (300 B.C.), who held the belief that the gods of mythology were simply deified mortals. Then, the new discipline is based on the idea that some myths and legends can be explained in terms of actual geological events witnessed by various groups of people. (Vitaliano 1973).

In the present study, it is fundamental that the route traced in *The Tempest* by the Court Party is similar to that traced for Aeneas in the Aeneid. This cannot be relegated to the background, as many have done embracing the trend of interpretations based on the Bermuda hypothesis. In fact, the journey that the characters make, from a geophysical and naturalistic point of view, is a journey into the land of volcanoes.

To sum up, it is our intention to analyse all that in the play is connected to a real location in terms of an environmental and geophysical asset, using sources from geoscience studies, historical and others. We are encouraged in this by the rich naturalistic vocabulary present in the play with terms identifying specific flora and fauna, and even geological and geophysical features (see Tab.1).

After introducing the play also referring to the period of the English Renaissance, we will address one of the unsolved questions among literary scholars: the location of Prospero's island taking into consideration the Bermuda hypothesis and secondly the possibility of placing the island into a Mediterranean contest.

Finally, taking into account both the geology off the Sicily coast and the mythology of the Mediterranean area, we propose an interpretation of the verses in a new and so far never considered perspective.

2.1 Shakespeare and volcanoes

Despite the numerous publications, books and academic articles on Shakespeare and Science (Clark 2005; Mazzio 2009; Spiller 2009; Falk 2014;) and apart the books on the way WS deals with storms and weather (Jones 2015; Chiari 2019), only few studies address WS possible interest in other geophysical phenomena such as volcanic activity and how this can be inferred directly from his verses.

If earthquakes in WS's plays are treated in a short paragraph by Clark 2005, we cannot ignore the proximity of Great Britain to another land of volcanoes: Iceland, a nation including 31 active and

extinct volcanoes. As we read in Poole (2011), in the early modern time, an integral part of the debates, discussions and general curiosity about purgatory was its actual location. In analysing the possible implications, Poole argues that an important Icelandic volcano, Mount Hecla, was a prominent site in early modern cartographic representation, and was also an important location of the popular geography of the imagination. She also argues that Mount Hecla shimmers through Hamlet as the geographical locus of purgatory, the prison of Hamlet's father's ghost. After all, Hamlet's line "my imaginations are as foul/As Vulcan's stithy" (III.ii.79-80) is the first example the OED, 3 (Oxford English Dictionary) cites for the word "stithy" (a forge, smithy), indicating that here the god is associated with his underground workplace. She continues that the invocation to Vulcan in the line might be specific to Mount Aetna, but it could also be tied more generally to the neologism "Volcano", a word that the OED cites as the first English usage as being from Purchas ("1613 PURCHAS Pilgr. VIII.xiv. 686 A Vulcano or flaming hill, the fire whereof maybe seene…about 100 miles). The word also appears in John Florio 's Italian-English dictionary of 1598 ("a hill that continually burneth and casteth out flame and smoke). Poole concludes that a volcano very much in evidence in Shakespeare's part of the world in the late 1590s was not Mount Aetna so much as Mount Hecla, which erupted for six straight months in 1597. Anyway, contemporaries repeatedly equate Mount Aetna and Mount Hecla, as it can be inferred in a song composed in 1600 by Thomas Weelkes, one of England's most famed composer of madrigals.

Other interesting hints come from another author as we will see later (Roe 2011). All this relates to sub-aerial volcanoes. But considering underwater volcanism is more complicated as we have already remarked quoting Mercalli (1883). He emphasised the importance of conducting such studies on the submarine eruptions occurred in the Mediterranean Sea:

"Yet for geology the study of underwater volcanoes could almost be said to be more important than that of sub-aerials, since, as it is known, the large pile of layers accessible to the geologists' investigation, and which also constitute the soil of our peninsula, is almost entirely of submarine origin". (Mercalli 1883 translated from Italian by the author).

At the same time, Mercalli supposed that accounts for eruptions occurred in the immense solitude of the seas must be sporadic. The 1846 eruption (of which we refer later in this paper), perhaps would have remained unknown if a captain of a merchant vessel had not accidentally been a spectator. In the Sicily Chanel and all around the coast of Southern Italy, volcanic phenomena are frequent also today. Just to mention the most recent, in November 2002 there was an important degassing event at sea out of the coast of Panarea Island (Capaccioni et al. 2005). WS may also have used sources on volcanic phenomena occurring at sea. Probably he learned about it from the captains and the sailors he came in contact or maybe he read the board diary of the English vessels, not an absurd idea if we consider that in the Elizabethan age Britain had resumed the commercial expansion in the Mediterranean (De Vitiis 1986). But here we can just speculate, since an historical research on volcanic phenomena at sea occurred in the past have not yet been performed.

The fascination for volcanoes also comes directly from the classics. Apart from the Epic, volcanic activity has been described by Pliny the Younger in the already mentioned letter to Tacitus. A milestone source about the possible effects of volcanism are Plato's *Timaeus* and *Critia*. In these works the philosopher speculates about Atlantis, an island suddenly destroyed by a catastrophic event. For some scholars, Plato took inspiration from the Egyptian records of the Thera eruption (Santorini). While other interesting descriptions come from *The Geography* of Strabo.

2.2 Tempests, storms and sea eruptions

Before going further, we clarify the difference between sea storms and sea eruptions. The word "tempest" is defined in dictionaries as a violent storm, with high winds that can be accompanied by rain, hail or snow. It is a word with Latin origin, and its etymology indicates an evolution from "period of time" to "period of weather" to "bad weather" to "storm". The word evolved to include also a figurative sense of "violent commotion". WS uses the word "tempest" in this double meaning, when the tempest is also the turmoil of the characters in a state of temporary and disarming confusion.

In the first scene of the play, we assist to a storm, or at least so it seems. Immediately after, already in the second scene of the play we learn that the storm is the product of Prospero's potent art, and we assist to a second description of it through the words of Ariel reporting how he caused the calamity following Prospero's directions. Another description comes in this occasion by Miranda witnessing the shipwrecking from the shore (descriptions analysed in par. 5.1 and 5.2). The initial fatality is reiterated in the words of some characters, during the play.

What happen to the sea during a storm? Its surface is strongly affected by the wind force, in this case waves are created by the friction between wind and surface waters, and are said wind-driven waves or surface waves. In other words, surface waves are the product of the interaction between the sea and the atmosphere of our planet. The first scene of the play describes the storm with the words typical of a storm: thunder and lightning. The boatswain uses words typical of a windstorm such as "blow", "wind", "storm". The word "fire" in this description does not appear neither once (I.i.)

Other hazardous waves can be the result of underwater disturbances that displace large amount of waters quickly such as earthquakes, landslides or volcanic eruptions. This type of waves can also cause tsunamis. The main difference with the previous types of waves is that in this case the great amount of energy released from within the Earth travels up to the surface, displacing water and raising it above the normal sea level.

In particular, during a submarine eruption we observe, as for sub-aerial volcanoes, the rising of super-heated molten rock (magma) along with ashes and gases. What happen on the surface of the sea depends on how the water and the magma interact, in relation to the depth of the volcano seabed (Németh & Kòsic 2020). In shallow waters, where water depths are less than 100 meters, hydro-volcanic explosion can be violent, but increasing water depth significantly decreases the explosive energy of the eruptions as the expansion of steam becomes limited (Zimanowski, B. et al. 2003; Clague, D.A. et al. 2000).

A volcanic eruption produces earthquakes, since the magma exerts pressure until it cracks the rock. As we will see later (par. 5.2), in *The Tempest* the descriptions of the initial fatality in the following verses of the play is fairly different from the initial scene and correspond better to a sea eruption. The reasons why the initial scene of the tempest is different from the description given by Ariel in vv. 193-206 I.ii and in that given by Miranda observing the event from the shore in verses I.ii. 3-4 (see par. 5.1 and 5.2) could be only speculated. Maybe putting into scene a sea eruption would have been difficult; or maybe WS wanted to emphasize that the initial catastrophic event was the product of Prospero's magic art, and in doing so he took inspiration from another natural event certainly more impressive, even if simply described by words.

3 Shakespeare's locations

In fig. 2 the map shows the locations of the Shakespearean works. It is immediately evident that most of the plays are located in the U.K and in Italy. Specifically, one third of the plays is located in Italy. There is a lot of literature about the interest that WS nourished for the country. He knew so much about it, even in detail, that some recent studies speculated that the works of WS can be studied only in the light of his relation with John Florio (Gerevini 2008). Two plays are located in Sicily: *Much Ado about Nothing* (Messina); *The Winter's Tale* (Sicily).

We believe that also *The Tempest* is located in Italy, somewhere in the Sicilian Sea, even if the official location of the play is simply "an uninhabited island". Almost all the characters are Italians and a precise route is indicated in the southern part of Italy (see Fig.4).

4 Introducing The Tempest

The Tempest is the last play entirely due to WS. It was written probably between 1610-1611 and performed for the first time on 1 November 1611 at Court. It was published later in the *First Folio* of 1623 from an edited transcript by Ralph Crane, the scrivener of the King's Man, the theatrical company to which WS belonged for most of his career. (for a synopsis see Fig. 3)

It is a work that is strongly affected by the period in which it was written. In the Elizabethan Age the emerging scientific disciplines like astronomy, chemistry, physics coexisted with the fashion for occultism, magic, cabalism, astrology and alchemy, the two main currents of thought that Bloch defines "cold" and "hot" (Bloch, 1972). The protagonist is the new Renaissance magus, astrologer and alchemist, owner of a deep knowledge and able to discover the secret processes of nature with the intent to control it. During the Reign of James I, when *The Tempest* was for the first time performed, the interest for occultism had not yet faded away. Nevertheless, we observe a slow decline of the Renaissance magus. John Dee (1527 – 1608), a mathematician, astronomer, astrologer and occult philosopher, and an advisor of Queen Elizabeth I, was accused several times of sorcery. He died in poverty under the reign of James I. What happened in Dee's lifetime – write F. Yates (1975) – to his "Renaissance Neoplatonism" was happening all-over Europe, as the Renaissance turned into the darkness of the which-hunts. However, the occult disciplines gave their contribution to the development of thoughts reaching its climax in the intellectual revolution initiated by Francis Bacon. The English philosopher contributed to the spreading of the scientific method based on experiments and mathematics elaborated by Galileo Galilei, the father of modern science.

The main character of *The Tempest*. Prospero, as J. Dee, is a magician. However, the way Prospero speaks and behaves seems to recall the new empiric method in development to observe nature. He may have been inspired by the astronomer Tycho Brahe, and his island/observatory, Uraniborg. WS lived during a remarkably eventful period in terms of celestial drama: passages of comets, solar eclipses, and moreover the appearance of a bright new star in the constellation of Cassiopeia, in November 1572. It was so bright that for several months it outshone even Venus. It was observed by Digges in England, and monitored even more closely in Denmark by astronomer Tycho Brahe. Today the star is named "Tycho's star" (Falk 2014).

Marnieri maintains that Prospero is conscious of the new rational science which is becoming the dominating culture of the age (Marnieri 2013). Not only Prospero uses the adjective "rough" when referring to his magic. Also, commentators remark the halo of ambiguity that concerns Prospero's

books. We learn from his own words, that he is a sort of researcher rapt in secret studies (I.ii. 72-77). He also mentions Gonzalo's good hearth with respect to his loved books (I.ii 164-168). But, remarks Marnieri, when he solemnly pronounces his renunciation to magic art, he speaks about one "book" he will "drown" (V.i. 50-57)

Of not less importance is another role of Prospero. Besides being a father, a duke, a scientist, a magician, a colonizer, Prospero is mainly a director. In this perspective the island is a stage, and the play becomes also a way to meditate on theatre as a form of art (metatheatre) (Knight 1932; Frye 1986; Lombardo 1986). This raises questions of fundamental importance for the text and its performance, since the theatrical representation that the public attends contains and often overlaps the other representation, which is the one staged by Prospero (Lombardo 2002). In this perspective, we can suppose that it must have been a work for WS to convince the audience that the storm was an illusion, after the first scene, where the mariners were supposed to enter the scene wet.

4.1 The Island of the Tempest: the Bermuda Hypothesis

Even if there are geographical indications on how both Prospero and Miranda, and then King Alonso of Naples and his crew reached it, the island is a multifaceted place, both in the philosophical-political and geographical-environmental sense. It is the place where the great Renaissance themes revive: the philosophical utopia, the boundaries of human knowledge, the the dominion of nature. We recognize the world of the great journeys, of the newly discovered lands. In the relation between Prospero and Caliban, the savage and deformed slave, we recognize the relation between England and America, the invaders and the natives (Knight 1984). It is generally agreed that WS read the essay of Montaigne *Of Cannibals*, in the translation of J. Florio, where Montaigne compares "cannibalism" of some indigenous population in Brazil to the "barbarianism" of the 16th-century Europe. (Florio 1892)

If we think of the philosophical and political asset, as described above, we can certainly agree that WS used sources to get more acquainted with the New World. It is widely accepted that he used the

Bermuda Pamphlets as a source of the play, a series of narratives of a wreck occurred during an expedition for the colonization of Virginia. In particular, *A true repertory of the wreck and Redemption of Sir Thomas Gates Knight* (Strachey 1625), a letter Strachey wrote to a never identified woman at the English Court. In the letter Strachey reports the 1609 shipwreck on the uninhabited island of Bermuda of the colonial ship *Sea Venture* which was caught in a hurricane while sailing to Virginia. Despite the ship, that was run aground off the coast of the island, the crew stranded on it for almost a year before completing the voyage to Virginia.

Some commentators find difficult to accept that WS could have had access to confidential material reporting a wreck near Virginia, when the English government was so intent in organizing expeditions to colonize the new lands. The letter was in fact published many years later in 1625. Nevertheless, the letter circulated in an informal way and a copy was found in 1616, the year he died, among Hakluyt's belongings, a leading adventurer and a member of the Virginia Company's counselling. (Gerevini 2008)

4.2 Echoes of the Bermuda in The Tempest

In reading the Strachey's letter, we can easily find in the play echoes of the faraway transoceanic lands inhabited by spirits and devils. *The Tempest* eventually took the atmosphere created by the collective imagery concerning these lands considered, wrongly according to Strachey (1625), uninhabitable:

"And hereby, also, I hope to deliver the world from a foul and general error, it being counted of most that they can be no habitation for men, but rather given over to devils and wicked spirits; whereas indeed we find them now by experience to be as habitable and commodious as most countries of the same climate and situation, insomuch as if the entrance into them were as easy as the place itself is contenting, it had long ere this been inhabited as well as other islands". (Strachey 1625)

Strachey then describes the nature of the soil, that is one and the same. "The mold dark, red, sandy, dry and uncapable, I believe, of our commodities or fruits". He also writes "there is not through the whole

islands either champaign grounds, valleys or fresh rivers". Then he describes the flora mainly with palm trees, cedar and prickly pear. And also emphasizes that there were no rivers nor running springs of fresh water. The only water to be found in the ground is that coming from the rain:

"When we came first we digged and found certain gushings and soft bubblings, which being either in bottoms or on the side of hanging ground, were only fed with rain water, which nevertheless soon sinketh into the earth and vanisheth away, or emptieth itself out of sight into the sea, without any channel above or upon the superficies of the earth". (Strachey 1625)

He finally describes a very rich fauna especially for what concern fishes.

Despite the atmosphere previously described, none of the ecological traits described in Strachey's letter can be found in Prospero's island, where there is no indication of tropical vegetation. Instead, trees typical of temperate climates are described: oaks, pines, wild apple trees, kernels, as well as bushes that produce berries (Brazzelli 2009). Caliban refers to the fertile areas of the island. Speaking to Stefano and Trinculo he says "I'll show thee every fertile inch o' th' island" (II, ii, 148) and also the springs of fresh water "I'll show thee the best springs" (II,ii,169). From his early interaction with Prospero we learn that the island has different type of waters: "fresh spring" and "brine-pits". The multiple references to rivers and ponds, including a "foul lake" (IV, i, 183), and brambles (" briars ") and other thorny bushes, allow us to identify a real ecology of the island. The tree in which Ariel has been imprisoned for 12 years, before being released from Prospero, is a pine. "Line trees" (V, i, 10), which are not tropical trees, protect from the weather, the entrance of the cave - home of Prospero.

We are also able to identify the geology of the island (Fitz 1975). We know that the coast is cut by coves or nooks, since Ariel feels obliged to explain to Prospero in just which nook he chose to hide the ship (Ariel, I.ii.226-29). We know that there are banks, since Ferdinand sits on one to weep (I.ii.389-90) We know from Ariel that the sands are yellow (I.ii.376) We know that there are large rocks with caves in them, for Caliban lives in one of them (I.ii.389-90) and Stefano hides his stolen liquor in another

(II.ii. 137-38). There are streams and ponds, some fresh (I.ii.339; II.ii.164; II.ii.75) and some polluted (IV.i.182).

For what we have until now described, we can for sure assert that the island of *The Tempest* it is not a tropical island. There are not even any palm trees – Fitz emphasizes – the prime requisite for a modern tropical island, although Shakespeare speaks of palm trees in other plays.

4.3 Placing the island into a Mediterranean context

If Ariel in I.ii.229 is said to bring his master the "dew/From the still-vexed Bermudas, the "south-west wind" that Caliban invokes against Prospero and Miranda (I.ii.320-325) is the "libeccio" a typical Mediterranean wind. Not to mention the several occasions in which we can literary "smell" the island, with typical smells of volcanism as in the following conversation:

Adr. The air breathes upon us here most sweetly
Seb. As if it had lungs, and rotten ones
Ant. Or as "twere perfum'd by a fen (II.i.45-7)

An important source of *The Tempest* is Virgil's *Aeneid*. The Court Party follows a route very similar to that of Aeneas: from Tunis (the Old Carthage), in North Africa, to Naples near Cumae where Aeneas meets the Sibyl (see Fig.4 for Aeneas' route). In an apparently aimless conversation among Gonzalo, Alonzo and Sebastian, Gonzalo insists on identifying Carthage with Tunis and the other two insist on repeating the name of Aeneas and Dido

Adr. Tunis was never grac'd befor with such a
Paragon to their Queen
Gon. Not since widow Dido's time|
Ant. Widow! A pox o' that! How came that

Widow in? Widow Dido!
Seb. What if he had said "widower Aeneas" too?
Good Lord, how you take it?
Adr. "Widow Dido" said you? You make me
Study of that: she was of Carthage, not of Tunis
Gon. This Tunis, sir, was Carthage (II.i. 71-87).

C. Still states that WS accentuated the importance of this reference to Dido with the ignorance of the disputants (Still 1921). While the question of Antonio "How come that widow in?" draws the attention to the parallel between the experience of the Court Party and that of Aeneas in Book IV of the *Aeneid* (Kott and Miedzyrzecka 1977)

As from the first scene of the play, a storm surprises the Court Party while they are navigating from Tunis to Naples. As we can see in the map (Fig.4), the first tract of the sea is the Sicily Channel. The hazard of the Sicilian Sea has been known since ancient times. In his journey to Italy, Aeneas was advised by Eleno of Burtroto to avoid Scylla and Charybdis. He did so, and after having been near the Etna, Aeneas reached Eryx (near Trapani) where his father Anchise died. He, then, decided to go back to Carthage. During the trip, Juno, who hated the Trojans provoked a tempest against the fleet. (*Aeneid* I, 81-222).

In the *Act of the Apostles*, Paul of Tarsus, persecuted by the Jews and imprisoned, asked, as a Roman citizen, to be tried in Rome. Under the Governor Porcius Festus, he was sent in Rome by sea. His boat shipwrecked and the crew reached Malta (The Acts of the Apostles 27; 28 1-10). Echoes of this shipwreck can be found in Prospero's account on the tempest to Miranda "No, not so much perdition as a hair" (I.ii.30), repeated then by Ariel reporting to Prospero "Not a hair perish'd" (I.ii 219)

Following Aeneas' route some commentators identify the islands of *The Tempest* with Pantelleria. Others, crossing the itinerary of the Court Party with the events of Sycorax who arrived on the island

from Algiers, search the island along the North Africa coasts, identifying it with the island of Lampedusa or Malta (Kott 1974). More recently, R.P. Roe has advanced the hypothesis that the island is in the Tyrrhenian Sea in the Aeolian archipelago. Roe even pointed the island of Vulcano as the possible location of the play (Roe, 2011). He maintains that Vulcano, as Stromboli, possesses an active volcano. It is the Gran Cratere, or La Fossa di Vulcano, and is especially noxious and deadly. That's why no one felt confident enough to live permanently on the island until fairly recently. With respect to *The Tempest*, in particular Roe writes about the "hot mud pools" to be found in Porto Levante in Vulcanello, a peninsula to Vulcano. The largest of the pools is impressive with carbon dioxide and sulphur dioxide effervescing through the muddy mixture of mineral sludge. The brownish goo bubbles and steams, and stinks mightily. The allusion to this hot mud pool is in IV.i.181-184 where Ariel refer to Prospero how he settled the three, Caliban, Stephano and Trinculo organizing a conspiracy against him (*Ari.* … At last I left them |I'th filthy mantled pool beyond your cell, |There dancing up to their chins, that the foul lake| O'erstunk their feet.) Verses emphasized later by the entering of the three in the scene soaked with the waters of "the filthy-mantled pool…the foul lake" and stinking to high heaven (*Trin.* "I do smell a horse-piss; at which my nose is in great indignation" IV.i.199-200)

The setting portrayed through the words of Trinculo, Stephano and Ariel, "foul lake", "horse piss", "filthy pool" – concludes Roe – describe exactly the stinking, bubbling, hot mud pool of Vulcano. Roe explains also Ariel defining mud pool with the word "filthy mantled". At the time of WS Vulcano's hot mud would have been "mantled", that is, covered by a floating crust of dry sulphur, and it would have been covered throughout the entire year. This curious natural phenomenon occurs when bright yellow particulate of sulphur, drifting down from the crater above, collects on the mud pool's surface. We can imagine the yellow dust remained untouched on much of the rim and slopes of the Gran Cratere, as it did on the hot mud pool in the playwright's day. It can therefore be concluded that the "yellow sands" the airy spirit sings about in the play ("come into these yellow sands" (I.ii.378-381)), refers to the colour of the sulphur.

Roe identifies further evidences in the flora and in the fauna, giving also an explanation for the word "scamels" remained always mysterious for commentators (*Cal.* …sometimes I'll get the / young scamels from the rocks II.ii.184-185). "Scamels are migratory marsh and shore birds, sometimes found along the Tyrrhenian Seas of Italy and occasionally on beaches in England, or other northern climes". Caliban mention also the Volcano's berries (*Cal.* …Thou strokedest me, and madest much of me;| Wouldst give me |Water with berries in it. I.ii. 333-334). To Roe these are clearly the mulberries, berries which proliferated in the wild of Vulcano when the playwright visited the island. Even today, an area on Vulcan is referred to locally as la "Contrada del Gelso" (the Mulberry district).

5 Natural hazards in The Tempest: a fire-based play

Despite the title, *The Tempest* is a fire based play. Not only for the mythological asset in which all that is suggested by nature becomes a place of expiation as in Dante's hell and in the mythological literature of the past. But also from a geo-environmental point of view. Counting words, the word "water" and "sea" are repeated fifty times in the text, compared to the thirty-four occurrences of air and the fifteen occurrences of "earth". The word "fire" has not the same frequency of quotations (eleven times) but it is present in the denotations and connotations of its essence (Marnieri 2013).

While water is deprived of its intrinsic power to wet, wrinkle clothes, drown people, the fire becomes so powerful and frightening that it infects the light of reason. Ariel in the form of fire become faster than "Jove's lightnings". The fire is evoked very often under the form of combustion phenomena. To the question why Prospero is so obsessed with woods, asking Caliban and then Ferdinando to continually bear logs, one may answer "firewood", and this is suggested by Miranda when she comforts the log-bearing prince Ferdinando with a personification: "When this burns |"Twill weep for having wearied you" (III.1.19-20) (Jensen 2016). This is also supported by G. Egan who argues that Prospero's main activity since his arrival on the island has been its deforestation. (Egan 2006).

Other important geo-physical phenomena connected with combustion are the St' Elmo fire and *ignis fatuus* (lit., "foolish fire"). Scholars generally agree that verses I.ii.96-101 evoke St Elmo's fire. This phenomenon is a type of luminous plasma discharge from a pointed object, in fields that carry a high voltage. They are often associated with areas of thunderstorms or volcanic ash activity and are completely harmless. A description of it appears also in the Strachey' s letter:

"Only upon the Thursday night, Sir George Somers, being upon the watch, had an apparition of a little round light, like a faint star, trembling and streaming along with a sparkling blaze, half the height upon the main mast and shooting sometimes from shroud to shroud, 'tempting to settle, as it were, upon any of the four shrouds. And for three or four hours together, or rather more, half the night it kept with us, running sometimes along the main yard to very end and then returning… But upon a sudden, toward the morning watch they lost the sight of it and knew not what way it made". (Strachey 1625)

Strachey himself remarks that this phenomenon is frequent in the Mediterranean Sea. St. Elmo's fire takes its name from St. Elmo (St. Erasmus, a martyred bishop of Italy, who died in 304). He was adopted by the sailors of the Mediterranean as their patron Saint. The phenomenon was familiar to the ancient Greeks, and Pliny mentions it in his *Natural History*. When it appeared as a single flame, it was Helena of Trojan war flame, and an omen of ill luck. As a doubled flame it was called Castor and Pollux, the guardian of sailors among the classical gods and therefore a good sign. Another description of St Elmo's fire appears in Hakluyt's "Voyages". It runs:

"I do remember that in great and boisterous storme of this foul weather, in the night, there came upon the toppe of our maine yarde and maine maste, a certain little light, much like unto the light of a little candle, which the Spaniards called the Cuerpo-Santo, and said it was St Elmo, whom they take to be the aduocate of sailers….This light continued aboord our ship abouth three hours, flying from maste to maste, and from top to top; and sometimes it would be in two or three places at once". (Hakluyt quoted by Clark 2005)

The other interesting phenomenon is the *ignis fatuus* (in the popular culture Jack-o'- lantern or will-o'-the wisp) "a phosphorescent light seen in the air over marshy places, supposed to be caused by the evolution and spontaneous combustion of some highly inflammable gas" (Fun and Wagall's New Standard Dictionary – quoted in Clark 2005). In IV.i. 197-198 Stephano mention it talking about Ariel to Caliban "Monster, your fairy, which you say is a harmless fairy, has done little better that play the Jack with us". Clark affirms that WS, perhaps, believed that the *ignis fatuus* and St' Elmo's fire were the same thing, or had a like cause, since he makes Ariel impersonate both phenomena. To us WS was adding wonder to wonder by exploiting the powerful imagery instilled by the use of fire.

5.1 A tempest or a sea eruption?

Till now we have collected evidence that *The Tempest* was inspired by the Mediterranean Sea. But when the tempest takes place in the play? We are able to learn the time in which the tempest takes place, since after having reported on the tempest performed, Prospero ask to Ariel the time (*Pros*. Ariel, thy charge| Exactly is perform'd: but there is more work. What is the time o'th' day?| Ari. Past the mid season. | The time 'twixt six and now| Must by us both be spent most preciously I.ii 238-241).

Then, the tempest occurs during the day and not at night. But as we read in the previous quotes about St Elmo's fire the phenomenon is visible at night. So, what was really describing WS with Ariel's words:

"Ari. I boarded the Kings' ship; now in the beak,
Now in the waist, the deck, in every cabin,
I flamed amazement; sometime I'd divide,
And burn in many places; on the topmast,
The yards and bowsprit, would I flame distinctly
Then meet and join". (I.ii.196-201)

It seems that St Elmo's fire is described just by the movements of Ariel performing the tempest, and nothing else. In reading the verses we don't get the impression of Ariel performing "certain little light, much like unto the light of a little candle" (Hakluyt) or of "a little round light, like a faint star, trembling and streaming along with a sparkling blaze" (Strachey). On the contrary, the imagery evoked in the verses is powerful and not evanescent as a St. Elmo's fire. In fact, this phenomenon provoked wonder in sailors but not in the sense that they could be injured by it.

Those scholars who do not agree with the Strachey letter as a source of the play have suggested other early modern texts as possible sources. Rea (1919) was the first one to propose one of the *Colloquia* of Erasmus, "Naufragium", translated in 1606 by William Burton. More recently, Stritmatter and Kositsky (2009) summed up all the critical issues regarding the "New World" interpretation of the play. In the final tables (Appendix A) there is a comparison among three possible sources for the storm (Ariosto's *Orlando Furioso* in the translation of Barbara Reynolds; Erasmus *Naufragium* in the 1606 translation; Strachey's *True Repertory*). In the last table where the present verses are considered, we can note that the other texts quote clearly the St. Elmo's fire (Ariosto) or mythological figures directly connected to them: "Castor and Pollux" (Erasmus and Strachey). Instead, in *The Tempest* there isn't a clear allusion to the phenomenon. Nor WS uses a word that let us imagine that at a certain point the "fire" vanishes. Even if the description of it as "ball of fire" in Erasmus can recall Ariel's description, remains the ambiguity already remarked by Rea (1919): St. Elmo's fire appears, in spite of the fact that is early afternoon. Rea argues that this discrepancy is to be found in Erasmus' narrative, and WS in following it do not notice that he has put it at the wrong time of day.

Another neglected aspect concerns the following verses I.ii. 201-206 that put the whole description into another geo-mythological context, since the deities here recalled are not Castor and Pollux, but Jove and Neptune. In reading the whole verses of Ariel's description, we even doubt that WS was describing a tempest:

"Pros. Hast Thou, spirit,

Perform'd to point the tempest that I bade thee?
Ari. To every article. I boarded the King's ship; now on the beak,
Now in the waist, the deck, in every cabin,
I flam'd amazement: sometime I'd divide,
And burn in many places; on the topmast,
The yards and boresprit, would I flame distinctly,
Then meet and join. *Jove's lightnings, the precursors*
O'th' dreadful thunder-claps, more momentary
And sight-outrunning were not: the fire and cracks
Of sulphurous roaring the most-mighty Neptune
Seem to besiege, and make his bold waves tremble,
Yea, his dread trident shake". (vv. 193-206 I.ii)

In particular, Neptune (the Greek Poseidon) is described intent on shaking his dreaded trident. In Ariel's words there is a war between the sky and the sea, where the sea is described as the "most-mighty Neptune". Neptune was also the god of earthquakes. And he was so powerful to frighten even Hades lord of the dead, as we read in the XX book of Homer's *Iliad*

"The sire of gods and men thundered from heaven above, while from beneath Poseidon shook the vast earth, and bade the high hills tremble. The spurs and crests of many-fountained Ida quaked, as also the city of the Trojans and the ships of the Achaeans. Hades, king of the realms below, was struck with fear; he sprang panic-stricken from his throne and cried aloud in terror lest Poseidon, lord of the earthquake, should crack the ground over his head, and lay bare his moldy mansions to the sight of mortals and immortals". (Iliad XX. 54-57)

The importance of this deity in the play is underlined by another circumstance. Caliban is very often described during the play as half man and half fish (*Trin*. …What| have we here? A man or a fish? dead or| Alive? A fish: he smell like a fish; a very | Ancient and fish-like smell II.ii. 25-28). And later again:

"Wilt thou tell a monstrous lie, being but half a fish | And half a monster?" (III.ii.31-33). There is another Greek god of the sea, Triton, who is the son of Neptune. Triton is represented as a merman with the upper body of a human and the tailed lower body of a fish. He was also depicted as having a conch shell which he would blow like a trumpet. Ovid describes him as "sea-hued" and with "shoulder barnacled with sea-shell" (Triton, sea-hued, his shoulders barnacled | With sea-shell, bade him blow his echoing conch| To bid the rivers, waves and flood retire. Ovid Metamorphoses 1. 332-335*)*.

This is not the first time that WS uses storms in his plays. As Clark remarks, thunder, lightning, darkness, and gales are there because they harmonise with the terror, despair, horror, and wickedness inherent in in his grim plots, and are intended to intensify the dramatic and tragic atmosphere. Often these are "shipwrecking storms", and losses at sea as in *The Tempest*, *Pericles*, *Othello* and the *Winter's Tale*. (Clark 2005)

How WS deals with storms and shipwrecking in the other plays? Do we find in the other descriptions words as "fire", or adjectives as sulphurous" or terms connected to earthquakes? We find words as "fire" and "sulphurous" associated with the sky and with storms (But never till to-night, never till now | Did I go through a tempest dropping fire *Julius Caesar* I.iii.9-10; "you sulphurous and thought-executing fire" *King Lear* III.2.4). And to go to the plays where storm is associated with shipwrecking, in *Pericles*, we find again the use of the adjective "sulphurous" associated with storm (Thy nimble sulphurous flashes (III.i.6), and in III.ii 14-15 we find, as in *The Tempest*, storm associated with earthquakes ("Our lodging, standing bleak upon the sea| Shook as the earth did quake").

Nevertheless, in *The Tempest* a question arises: how Neptune is here evoked, as the god of the sea or as the earth shaker? And the word "cracks" can recall us the descriptions reported in Shakespeare times about Mount Hecla? Poole (2011) reports that in Purchas we read on an eruption by Hecla in which "after the Earthquake followed a horrible cracke, that if all warlike Ordnace had beene discharged, it had beene nothing to this terrour" (p.648). The double nature of Neptune was very well known in ancient mythology. Neptune before being the god of the sea was conceived with an equine form, so it

was a deity originally linked to the earth. To maintain this double nature, he was also called in Greek mythology the "Εννοσίγαιον", literary the earth-shaker.

Do these verses evoke also earthquakes? When in the final part of the play Prospero resumes all the prodigies accomplished thanks to his potent art not only he says to have triggered a war between heaven and earth (*Pros*. …And 'twixt the green sea and the azured vault | Set roaring war V.i. 43-44); he also asserts: " *Pros.* …The strong-based promontory | Have I made shake V.i. 46-47). In a short paragraph dedicate to earthquakes in Shakespeare, Clark affirms that he had a limited knowledge of earthquakes feeling his own limitation due to a scarce experience of them. Eventually, WS was interested more with the effects of this catastrophic upheavals rather than embarking upon an effort to discover their obscure causes. This is the reasons why references in his plays are few (Clark 2005). Nevertheless, in *The Tempest* references to earthquakes seem not to be allegorical but more descriptive of natural phenomena.

5.2 Volcanism in the Sicilian sea and The Tempest

What has the Sea of Sicily to envy to the Bermuda triangle? Absolutely nothing. Its hazard has been known since ancient times, as we have already seen in historical accounts from the Epics and the Bible, and is often in the current chronicles for the route of the migrants approaching Italy from Africa. Archaeological and more recent remains found in the deep sea testify of a difficult navigation in dangerous water till present times. This is probably due to the complex geodynamics of Italy and the sea surrounding the peninsula, resulting from the evolution of the borders in between the African and Euro-Asiatic plates. Only recently the seafloor of the Sicilian Sea in proximity of the Sicily Channel has been an object of in-depth studies which reveal the complexity of the area (Corti et al. 2006; Falautano 2010; Cavallaro& Coltelli 2019). Tectonic extension led to an intra-plate rift system characterized by three tectonic faults and a number of underwater edifices, evidence of complex volcanic-tectonic phenomena (Corti et al 2006; Civile et al. 2015). A list of 105 islands (including major islands, islets, rocks and

stacks) recognized by the Sicilian Island Award (S.I.A.) (Muscarella & Baragona 2017) is also indicator of the complex geodynamics of the area.

Sea volcanism in shallow water not so far from the south of the Sicilian coast (at a distance of 50 km) has been well documented on the occasion of the emerging of the Ferdinandea Island in 1831 (see Fig 6 for the complexity of the seabed in this area). This has led to a monitoring since 1883 by the Italian Navy Hydrographic Institute. Recent hydrographic campaigns have located the most superficial point of the old volcanic building at a depth of 9 mt. This is a potential hazard for vessels (Sinapi et al. 2017). This represents the only well-documented volcanic event occurred in the area; other volcanic activities were uncertainly reported in the surroundings of Graham Bank during the first Punic war (264-241 BC) (Guidoboni et al., 2002; Bottari et al., 2009), in 1632, 1833, and 1863 (Antonioli et al., 1994; Falzone et al., 2009). Moreover, numerous episodes of strong gas releases in the Graham Bank area were observed in 1816 (Mercalli, 1883), 1845, 1942 and more recently in 2003. (Cavallaro&Coltelli 2019). In 2006, following the directions of Mercalli reporting the18th June 1845 sea eruption episode occurred in proximity of the Grahm bank, a sea expedition has revealed a huge undersea volcanic complex, with more or less the size of Mount Etna (Macaluso 2016).

As we have already said, a thorough study of how many volcanic episodes occurred in the past in the Sicilian sea has never been performed. We have also reported Mercalli's opinion on the importance of such studies (see. Paragraph 2.1). It is not out of place speculating that volcanic eruptions at sea in this area may have occurred also at the age of WS. How it would have appeared to those navigating the area is well described by the already quoted 18th June 1845 episode in Mercalli, which we report here in full:

"The 18th June 1845 at about 9.30 p.m., the English vessel Victory being at 36^{o} 44'36" latit. e 13^{o} 44' 36'' longit., was violently shaken and its two masts were suddenly overturned as under the effect of a terrible tempest even if in that moment the weather was calm. Suddenly, sulphurous exhalations spread over the air so intense that the crew was almost unable to breath. The vessel was a bit injured but moved

away and from far away the travellers saw three huge fire balls coming up from the sea and the phenomenon was visible for six minutes". (Mercalli 1883 translated from Italian by the author).

In our view, this description is not so different from the tempest described by Ariel's words previously analysed (vv. 193-206 I.ii) , where a storm occurs, but it is not raining "The sky, *it seems*, would pour down *stinking* pitch" says Miranda to Prospero after having witnessed the tempest from the shore (I.ii.3-4) and where the word "stinking" could recall us the sulphurous exhalation of the previous description; crew don't get wet (*Ari:* "On their sustaining garments not a blemish, but fresher than before (I. ii. 218-219); where the fire blazes in different places as the three huge fire balls in the description reported in Mercalli (Ari: I'd divide| And burn in many places; on the topmast, | The yards and boresprit, would flame distinctly,| then meet and join Act I.ii 198-201). Moreover, words related to the wind, as in the first scene, are completely missing.

A possible ancient source for *The Tempest* is *The Geography* of Strabo reporting an episode out of the Aeolian Island in the Tyrrhenian sea. Volcanism in this area is very well studied and even recently in proximity of Basiluzzo, scientists have discovered what they have called a "smoking land" (Esposito 2018). In the following, Strabo describes sea volcanism in between Vulcano and Panarea:

"Again, many times flames have been observed running over the surface of the sea round about the islands, when some passage had been opened up from the cavities down in the depth of earth and the fire had forced its way to the outside. Poseidonius says that within his own recollection, one morning at daybreak, about the time of summer solstice, the sea between Hiera (Vulcano) and Euonymus (Panarea) was seen raised to an enormous height, and by a sustained blast remained puffed up for a considerable time, and then subsided; and when those who had the hardihood to sail up to it saw dead fish driven by the current, and some of the men were stricken ill because of the heath and stench, they took flight; one of the boats, however approaching more closely lost some of its occupants and barely escaped to Lipara with the rest, who would at times become senseless like epileptics, and then afterwards would recur to their proper reasoning faculties". (*The Geography* of Strabo 6.2.11)

In *The Tempest*, the event occurring out of sea, besides being described by Ariel to Prospero in the verses already quoted, is also witnessed by Miranda from the shore. She clearly says:

"The sky, it seems, would pour down stinking pitch,
But that the sea, mounting to th' welking's check,
Dashes the fire out" (*Mir*. I.ii. 3-4)

The words recall Strabo's description ("the sea between Hiera (Vulcano) and Euonymus (Panarea) was seen raised to an enormous height*").* In the excerpt quoted, Strabo reports also the effects of gas-inhaling, frequently described in local mythology. The effects of gas-inhaling is reported also in *The Tempest*, when those characters surprised by the tempest, are described in Ariel's words (*Pros.* My brave spirit! | Who was so firm, so constant, that this coil| Would not infect his reason? *Ari.* Not a soul| But felt a fever of the mad, and play'd| Some tricks of desperation. I.ii. 206-210).

Did Shakespeare have access to Strabo? It is not absurd thinking that *The Geography* of Strabo circulated at the time of Shakespeare. The importance of geographical studies in early modern England is underlined in an article (Cormack 1998). In particular Strabo is pictured in the title page of a printed commonplace book.

5.3 The Tempest in the light of Geo-mythology

WS's familiarity with volcanism in the Mediterranean is also supported by the mythology present in the play. In this sense, we may consider WS a further witness of volcanic phenomena taking place in the Mediterranean.

The already quoted gas-inhaling is present in Mediterranean mythology describing the activities of the Pythia, the priestess at Delphi in Greece. The Oracle at Delphi appears in the *Winter's Tale*, a play

contemporary to *The Tempest* and written in between 1609-1611. Geologists and toxicologists have argued that the trance-like state of the priestess, the oracle at Delphi, was not just a piece of fantasy (Piccardi 2000, Spiller et al. 2002). One may think that also the Sybil in Cumae where Aeneas stopped over for prophecies during his trip to Rome may have prophesied under the effect of gas-inhaling. The philosophers of the time (Sophocles, Strabo, Virgil) report of an oracle of the dead in the Phlegraean Fields, near Lake Avernus (around Naples, Italy), a very active volcanic area with sulphur vents and boiling springs. The Sibyl, a prophetess, was considered the bridge between the living and the dead. The places evoked in *The Tempest* thorough the route of the Aeneas/Court party are very often associated with hell because of the volcanism. The Averno lake was considered one of the passage to hell as the Etna. Eventually Sicily was considered for its volcanism the land of the devils, not less than the Bermuda Islands (*Ari* …the King's son, Ferdinand, |With hair up-staring, then like reeds, not hair, - | Was the first man that leap'd: cried, "hell is empty, |And all the devils are here" I.ii213-215)

In Act IV.I to celebrate the marriage between Ferdinando and Miranda, Prospero put into scene a masque where the protagonist is Ceres (the Greek Demeter) whose daughter was raped by Pluto, the king of the hell. Was this myth imported by Greece or was it conceived directly in Sicily? Classical sources as Diodorus Siculus, Cicero, Ovid places the myth in Enna in Sicily. Near Enna there is a lake, Pergusa, that is believed to be the place where Pluto raped Proserpina.

"Not far from Henna's walls there is a lake, Pergus by name, its waters deep and still; it hears the music of the choiring swans as sweet as on Caystros' gliding stream. Woods crown the waters, ringing every side, their leaves like awnings barring the sun's beams. The boughs give cooling shade, the watered grass is gay with spangled flowers of every hue, and always it is spring. Here Proserpina [Persephone] was playing in a glade and picking flowers, pansies and lilies, with a child's delight, filling her basket and her lap to gather more than the other girls, when, in a trice, Dis [Haides] saw her, loved her, carried her away--love leapt in such a hurry*!" (*Ovid, Metamorphoses 5. 462*)*.

This myth is associated with the idea of death and rebirth, as the succession of the seasons but also with the destruction provoked by volcanic eruptions and the following florid re-birth. The most important element associated with Ceres, the goddess of fertility, was the grain. The grain and the volcanoes are the two most important elements associated with ancient Sicily. In ancient mythology Ceres contended the island with Hephaestus the god of volcanoes. In that occasion the nymph Etna (who gave the name to the most important Sicilian volcano) was the intermediate.

Finally, Ariel disguised as a harpy interrupts the scene of the banquet (III.iii). Aeneas meets harpies in the Strofades islands in Greece. Virgil put these figures in the lobby of the hell.

Conclusion

In the present paper we collected evidence that for the "unknown island" of the Tempest WS took inspiration from the Mediterranean. We have also suggested that some verses of *The Tempest* rather than describing a storm describe phenomena of volcanic origin. WS could therefore have been inspired by accounts and sources describing Sicily and the Sicilian sea. Its hazard has been known since ancient times. The sea was renown for the "strange things" happening into it: balls of fire, sulphurous exhalations, dead fishes and violent storms occurring when the weather was calm. How amazing should have appeared all these phenomena to the people navigating these waters! Especially in the past when the study of volcanoes was moving its first steps. WS who used natural phenomena to intensify the most dramatic moments of his plot, knew those seas that the sailors dreaded. We don't know if WS ever visited these places. As we have reviewed, he used ancient sources as Virgil's *Aeneid*, the *Bible*, *The Geography* of Strabo. But he may as well have used yet unknown sources as board diary of the vessels navigating those seas. His last play seems really to be a portrait of Sicily and the sea surrounding the island: the land of volcanoes, the land of the tempests of fire, the land of the devils!

Data availability. All data are freely available online and are part of the public domain.

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References

Antonioli, F., Donadio, C., Ferranti, L., Margottini, C., and De Vita, A. Il Banco Graham: storia, sismica storica, petrologia e geomorfologia subacquea. Nascita e scomparsa del vulcano sommerso nel Canale di Sicilia. Mem. Descr. Carta Geol. d'It. 52, 99–102, 1994

Bloch, E. Vorlesungen zur Philosophie der Renaissance, Suhrkamp Taschenbuch, Frankfurt 1972

Boschi E., P Gasperini P., Smriglio G., Valensise G. The new" Catalogue of Strong Italian Earthquakes", Ann Geophys-Italy, 18, 5-6, DOI: https://doi.org/10.4401/ag-4072, 1995

Bottari, C., Stiros, S. C., and Teramo, A. Archaeological evidence for destructive earthquakes in Sicily between 400 B.C. and A.D. 600. Geoarchaeology 24, 147–175. doi: 10.1002/gea.20260, 2009

Brazzelli, N. An Island Nowhere. L'isola della Tempesta tra geografia e immaginazione. Annali della Facoltà di lettere e Filosofia dell'Università degli studi di Milano LXII. 1, 131- 153 http://hdl.handle.net/2434/56358 , 2009

Buettner, R.; Dellino, P.; Zimanowski, B. Identifying magma-water interaction from the surface features of ash particles. Nature, 401, 688–690. https://doi.org/10.1038/44364 , 1999

Capaccioni B., Tassi F., Vaselli O., Tedesco D., Rossi P.L., The November 2002 degassing event at Panarea Island (Italy): five months of geochemical monitoring Ann Geophys-Italy 48, 4-5, 2005

Cavallaro, D. & Coltelli, M. The Graham Volcanic Field Offshore Southwestern Sicily (Italy) Revealed by High-Resolution Seafloor Mapping and ROV Images Front. Earth Sci., 7- 311 https://doi.org/10.3389/feart.2019.00311 2019

Chiari, S. Shakespeare's representation of weather, climate and environment. The early modern "fated sky". Edinburgh University Press. 2019

Civile, D., Lodolo, E., Zecchin, M., Avraham, Z.B., Baradello, L., Accettella, D., Cova, A., Caffau, M., The lost Adventure Archipelago (Sicilian Channel, Mediterranean Sea): Morpho-bathymetry and Late Quaternary palaeogeographic evolution", Global Planet Change, 125, pp. 36– 47, 2015

Clague, D.A., Moore, J.G., Reynolds, J.R. Formation of submarine flat-topped volcanic cones in Hawai'i. Bull. Volc., *62*, 214–233. https://doi.org/ 10.1007/s004450000088, 2000

Clark, C. Shakespeare and Science, Uni. Press of the Pacific 2005

Cormack, L.B., Britannia rules the waves? Images of empire in Elizabethan England, Early Modern Literary Studies 4.2/Special Issue 310.1-20 http://purl.oclc.org/emls/04-2/cormbrit.htm (last access: 14 December 2020) 1998

Corti, G., Cuffaro, M.,Doglioni, C., Innocenti F., Manetti, P. Coexisting geodynamic processes in the Sicily Channel, Geol. S. Am. S. 409 83-96 2006

De Vitiis, G.P. Il Mediterraneo nel XVII secolo: L'espansione commerciale inglese e l'Italia. Studi Storici, 27-1, 109-148, 1986

Egan, G. Green Shakespeare: from Ecopolitics to Ecocriticism. Routeledge, New York 2006

Esposito V, Andaloro F, Canese S, Bortoluzzi G, Bo M, Di Bella M, et al. Exceptional discovery of a shallow-water hydrothermal site in the SW area of Basiluzzo islet (Aeolian archipelago, South Tyrrhenian Sea): An environment to preserve. PLoS ONE 13(1): e0190710. https://doi.org/10.1371/journal.pone.0190710, 2018

Falautano, G., Falzone, G., Lanzafame, G., Macaluso, D., Niosi, M., and Rossi, P. Primi Tentativi di monitoraggio dei resti sottomarini dell'eruzione che nel 1831 costruì l'Isola Ferdinandea nel Canale di Sicilia. Rapporti tecnici INGV, 125, 2010

Falk D. The Science of Shakespeare, Thomas Dunne Books, New York, 2014

Falzone, G., Lanzafame, G., and Rossi, P. L. Il vulcano Ferdinandea nel Canale di Sicilia. Geoitalia 29, 15–20, 2009

Fitz L.T., The Vocabulary of the Environment in The Tempest, Shakespeare Quarterly, 26. 1 42-47 1975

Florio, J. Queen Anna's new World of words, or dictionaire of the Italian and English tongues, Melch Bradwood, London, 1611

Florio, J. Of the Cannibals in The Essays of Montaigne done into English by J. Florio, pp 217-231 David Nutt in the Strand, London 1892

Frye, N. , The Tempest in N. Frye on Shakespeare, London 1986

Gerevini S. William Shakespeare, ovvero John Florio: un fiorentino alla conquista del mondo Pilgrim Ed. http://www.shakespeareandflorio.net 2008

Giacomelli L., Perrotta, A., Scandone, R. e Scarpati C. The eruption of Vesuvius of 79 AD and its impact on human environment in Pompei, Episodes, vol. 26,3 https://doi.org/10.18814/epiiugs/2003/v26i3/014. 2003

Guidoboni E. , Comastri A. and Traina G, Catalogue of Ancient Earthquakes in the Mediterranean area up to 10th century, ING-SGA Bologna 1994

Guidoboni, E., Muggia, A., Marconi, C., and Boschi, E. A case study in archaeoseismology. The collapses of the Selinunte temples (Southwestern Sicily): two earthquakes identified. Bull. Seismol. Soc. Am. 92, 2961–2982. doi: 10.1785/0120010286, 2002

Guidoboni, E., Ferrari, G., Tarabusi, G. *et al.* CFTI5Med, the new release of the catalogue of strong earthquakes in Italy and in the Mediterranean area. Sci Data 6**,** 80 https://doi.org/10.1038/s41597-019-0091-9 2019.

Homer, Iliad, translated by Samuel Butler retrieved from https://uh.edu/~cldue/texts/iliad.html. Last acces 2 dec. 2020

Jensen, R.T. The roles of trees in Shakespeare, Tolkien, and Atwood, Thesis University of Oslo 2016

Jones, G. Shakespeare's Storms, Manchester University Press, 2016

Jones N. F., Pliny the Younger's Vesuvius "Letters" (6.16 and 6.20) The Classical World Vol. 95, 1, 31-48, 2001

Knight G.W. The Shakespearean Tempest, London 1932

Knight G.W. Shakesperian Dimension Prentice Hall / Harvester Wheatsheaf 1984

Kott J., Shakespeare our contemporary, Norton, New York 1974

Kott, J. and Miedzyrzecka, D. The Tempest, or Repetition. Mosaic, Vol. 10, No. 3, 23-36 1977

Lanza, T. Negrete A., From myth to earth education and science communication, Geol. Soc.London, Sp, 273, 61-66, 1, https://doi.org/10.1144/GSL.SP.2007.273.01.06, 2007

Leigh, R.J., Casson, J and Ewald, D. A Scientific Approach to the Shakespeare Autorship Question, Sage Open, 10.1177/2158244018823465, 2019

Lombardo, A. Il testo e la sua performance. Per una critica imperfetta. Editori Riuniti 1986

Lombardo, A. La grande conchiglia. Due studi su La Tempesta. Bulzoni, Roma 2002

Macaluso, D. Vulcanesimo sedimentario e ricerca di idrocarburi in mare. La scoperta di un grande pockmark nello stretto di Sicilia. Geologia e Ambiente 2/ 2-16 2016

Marnieri M.T.. Prospero's Magic and the Role of the Four Elements. A reading of The Tempest. Revistas de Linguas Modernas 18, 13-44/ ISSN: 1659-1933, 2013

Mazzio, C. Shakespeare and Science, c. 1600. South Central Review 26. 1/2, 1-23. 2009

Mercalli, G. Vulcani e Fenomeni Vulcanici in Italia, Milano 1883

Muscarella, C, Baragona, A. The endemic fauna of the sicilian islands. Biodiversity Journal, 8 (1) 249-278 2017

Nemeth, K., Kósik, S. Review of Explosive Hydrovolcanism, Geosciences 10(2), 44 https://doi.org/10.3390/geosciences10020044, 2020

Ovid Metamorphoses. Translated by Melville, A. D., E.J. Kenney, Oxford University Press 1986

Piccardi, L. Active faulting at Delphi, Greece: Seismotectonic remarks and a hypothesis for the geologic environment of a myth. Geology, 28, 651 – 654. 2000.

Poole, K. Supernatural Environments in Shakespeare's England. Space of Demonism, Divinity and Drama. Cambridge University Press, New York 2011

Rea, J.D. A source for the storm in The Tempest. Modern Philology, 17-5, 279-286. 1919

Roe, P.R. The Shakespeare Guide to Italy. Retracing the Bard's unknown travels. Harper Perennial Ed. New York 2011

Shakespeare, W. The Tempest Ed. F. Kermode, The Arden Shakespeare, London 1986

Sinapi, L., Lamberti, L.O., Pizzeghello, N.M., Ivaldi, R. The Graham Bank: hydrographic features and safety of navigation, The International Hydrographic Review (15) 2017

Spiller, E. Shakespeare and the Making of Early Modern Science: resituating Prospero's Art. South Central Review, 26, ½ Shakespeare and Science, 24-41, 2009

Spiller, H. A., Hale, J. R. & De Boer, J. Z. The Delphi oracle: a multidisciplinary defence of the gaseous vent theory. Journal of Clinical Toxicology, 40, 189–196 2002.

Still, C. Shakespeare's Mystery Play: a study of The Tempest. C. Palmer, London, 1921

Strabo, The Geography, translated by H. Leonard Jones Harvard University Press, 2010

Strachey W., A true repertory of the wracke and redemption of Sir Thomas Gates Knight; upon and from the Island of the Bermudas, July 15, 1610. Purchase his Pilgrims, 4, IV Willaim Stansby for Henrie Fetherftone, London 1625

Stritmatter, R., Kositsky, L. "O Brave New World": "The Tempest" and Peter Martyr's "The Orbe Novo". Questioning Shakespeare. 21-2. 7-42, 2009

Stritmatter, R. "Small Latine and Lesse Greeke", Anatomy of a Misquotation, The Oxfordian, 17,

2017

Virgil, Aeneid translated by H.R. Fairclough, rev G.P. Goold Loeb Classical Library, Cambridge, MA, Harvard University Press 1916

Vitaliano, D. B Legends of the Earth. Their Geologic Origins. Indiana University Press, 1973

Werth, A. Shakespeare's "Lesse Greek", The Oxfordian V, 2002

Yates F.A. Shakespeare's Last Plays: A New Approach, Routledge and Kegan Paul 1975

Zimanowski, B., Wohletz, K., Dellino, P., Buttner, R. The volcanic ash problem. J. Volcanol. Geotherm. Res. 122, 1-5, https://doi.org/10.1016/S0377-0273(02)00471-7 2003

Figures

FLORA	FAUNA	GEOLOGY	TROPOSPHERE	Other geophysical phenomena
pine oak berries wither'd roots acorn bush shrub crabs pig-nuts filberts wheat rye barley veches oats pease broom-groves vineyards flowers tooth'd briers sharp furzes pricking goss thorns line line-grove cedar	wolves bears urchins toads beetles bats chanteclair fresh-brook mussels apes hedgehogs adders jay marmoset scamels sheep peacocks blind mole barnacles apes beer owls	deep nook ooze of the salt deep unwholesome fen fresh springs brine-pits hard rock cell yellow sands bogs fens flats rock turfy mountains banks bosky acres unshrubb'd down winding-brooks crisp channels green lands filthy-mantled pool foul lake pool lime	storm dew from the still-vex'd Bermoothes wind of the north south-west (wind) black cloud thunder	St. Elmo's fire (?) sea eruption (?) earthquakes (?) *ignes fatui*

895

Tab.1 The terms related to the Flora and Fauna, Geology and the Troposphere as collected by the author from the play. In the last column some geophysical phenomena as suggested from the verses analysed in the paper.

Figure 1: The Fedinandea island in a painting by Camillo de Vito 1831 source Wikipedia

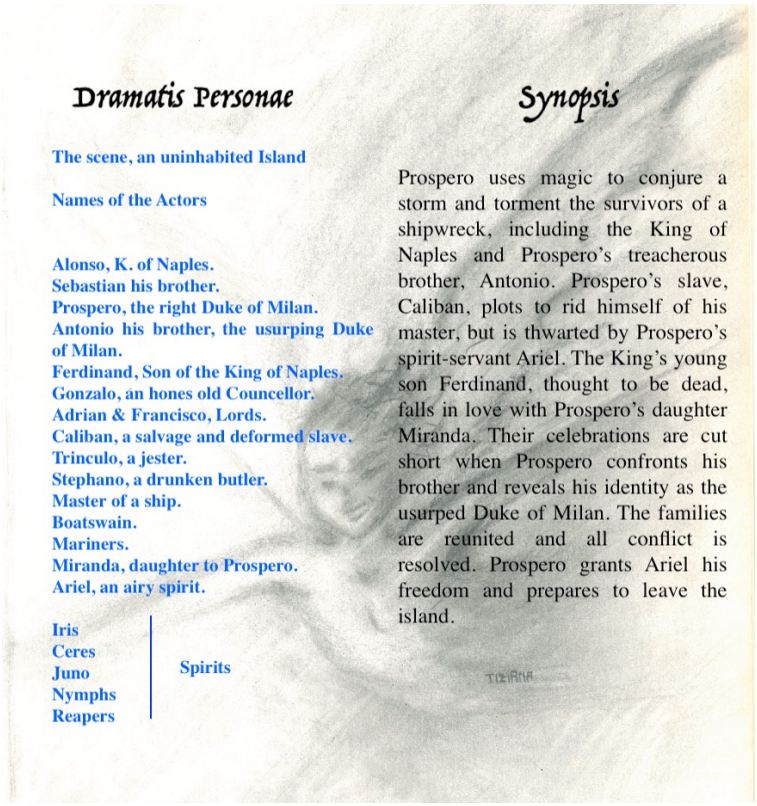
900

Figure 2: Shakespeare's Locations : map generated with Google Map by the author.

The icons in green and red colour indicate the plays located in Italy.

The red colour refers to the ones based in Sicily © 2020 Google

905



Dramatis Personae

The scene, an uninhabited Island

Names of the Actors

Alonso, K. of Naples.
Sebastian his brother.
Prospero, the right Duke of Milan.
Antonio his brother, the usurping Duke of Milan.
Ferdinand, Son of the King of Naples.
Gonzalo, an hones old Councellor.
Adrian & Francisco, Lords.
Caliban, a salvage and deformed slave.
Trinculo, a jester.
Stephano, a drunken butler.
Master of a ship.
Boatswain.
Mariners.
Miranda, daughter to Prospero.
Ariel, an airy spirit.

Iris
Ceres
Juno
Nymphs
Reapers
— Spirits

Synopsis

Prospero uses magic to conjure a storm and torment the survivors of a shipwreck, including the King of Naples and Prospero's treacherous brother, Antonio. Prospero's slave, Caliban, plots to rid himself of his master, but is thwarted by Prospero's spirit-servant Ariel. The King's young son Ferdinand, thought to be dead, falls in love with Prospero's daughter Miranda. Their celebrations are cut short when Prospero confronts his brother and reveals his identity as the usurped Duke of Milan. The families are reunited and all conflict is resolved. Prospero grants Ariel his freedom and prepares to leave the island.

910

Figure 3: Dramatis Personae as from Kermode ed.1986;
Synopsis from https://www.shakespeare.org.uk/
In the background Ariel, drawing from the author.

915

Figure 4: The route of Aeneas in the Mediterranean sea,
© Associazione Rotta di Enea http://www.rottadienea.it

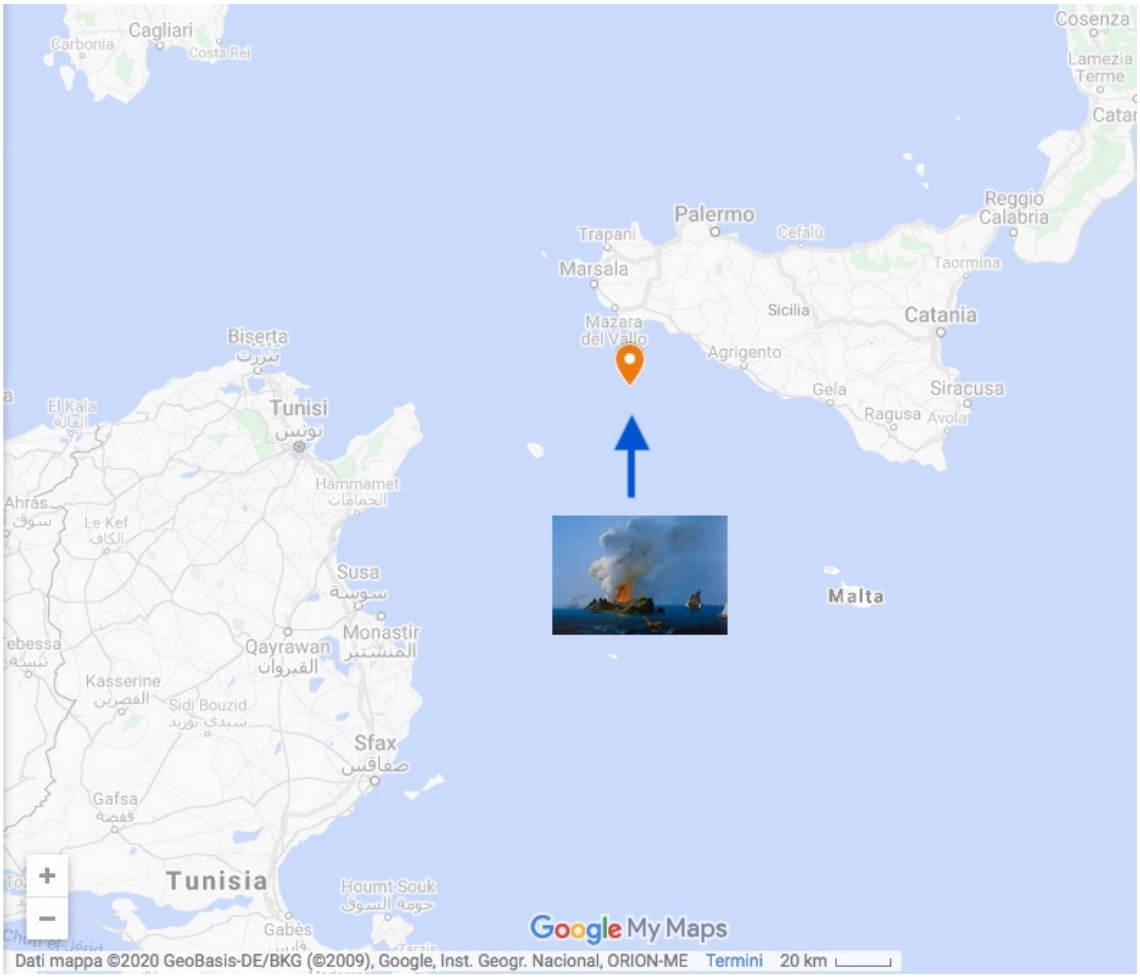


Fig. 5 Location of the Ferdinandea Island. The island is at just 8 m (26 ft.) below sea level and about 50 km from the shore. The map was generated by the author using google maps. © 2020 Google

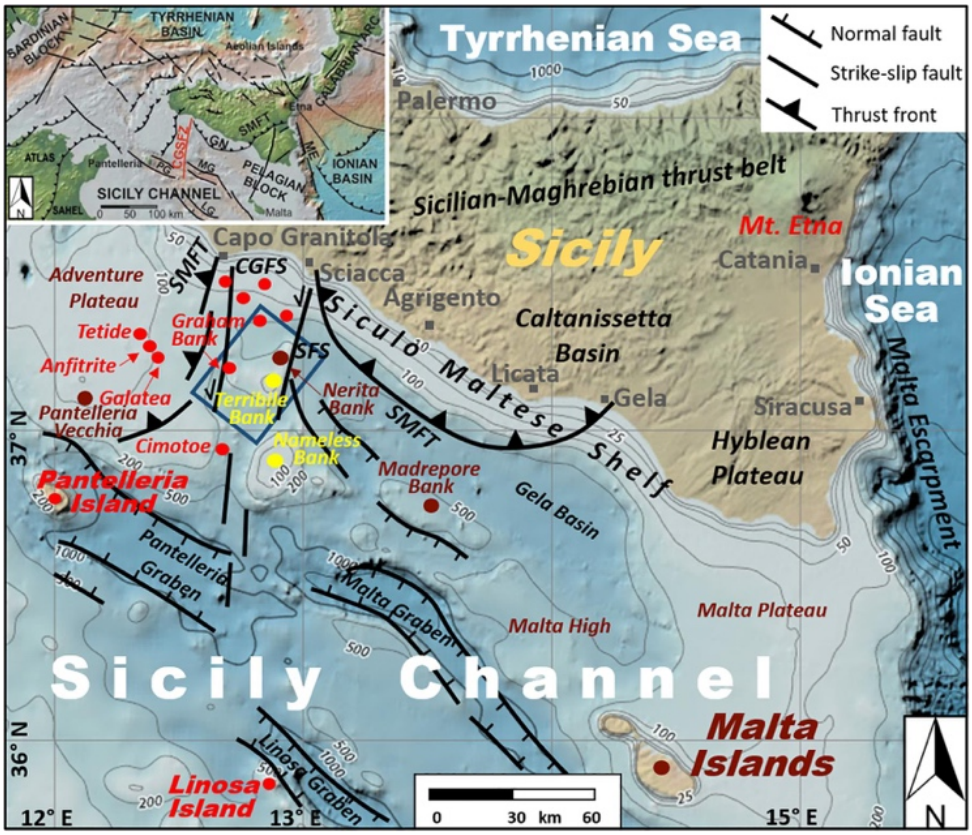


Fig.6 Shaded-relief bathymetric map of the northern portion of the Sicily Channel (from GEBCO-General Bathymetric Chart of the Oceans-Digital Atlas).; the red, brown and yellow circles indicate the location of volcanic centers, sedimentary banks and sedimentary banks with scattered volcanic manifestations on top. (From Cavallaro& Coltelli 2019)